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ABSTRACT

The study reported here was intended to "round out" the Graduate Record Examinations (GRE) Board's continuing study of special test preparation for the GRE General Test by providing information that was previously unavailable on the effects of one kind of special test preparation--self-test-familiarization for the verbal and quantitative sections of the test and for the revised analytical portion. The impact of receiving, and of being encouraged to study, the newly expanded "GRE Information Bulletin" and copies of disclosed forms of the GRE General Test was investigated in an experimental design in which randomly selected samples of test takers were encouraged to prepare in various ways for the test. In a previous similar study of the analytical section of the test, self-study was found to improve performance on two analytical item types that were subsequently removed from the test. In the present study, no practically significant effects were detected for the verbal, quantitative, or revised analytical sections of the test. Appendices include: (1) test-taking strategies for each section of the test; (2) suggestions for improving speed; (3) review for the quantitative section of the GRE Aptitude Test; (4) example of one sample test; and (5) letters of encouragement and nonencouragement. (Author/LMO)

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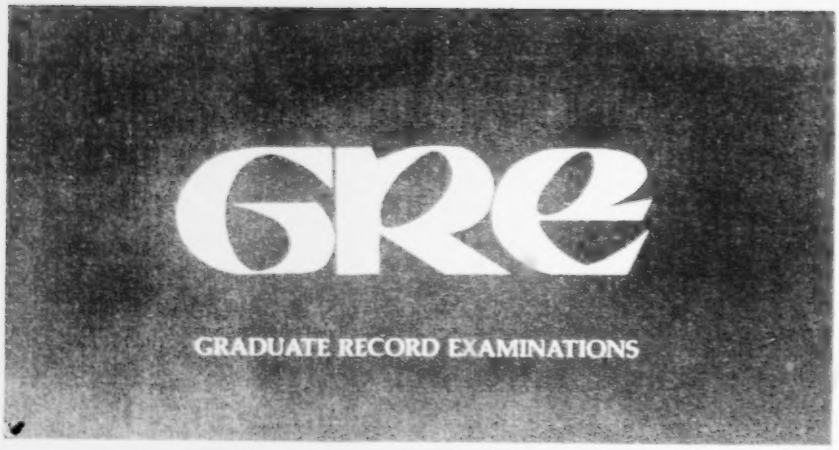

THE IMPACT OF SELF-STUDY ON GRE TEST PERFORMANCE

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Abstract

The study reported here was intended to "round out" the GRE Board's continuing study of special test preparation for the GRE General Test by providing information that was previously unavailable on the effects of one kind of special test preparation--self-test-familiarization for the verbal and quantitative sections of the test and for the revised analytical portion.

The impact of receiving, and of being encouraged to study, the newly expanded GRE Information Bulletin and copies of disclosed forms of the GRE General Test was investigated in an experimental design in which randomly selected samples of test takers were encouraged to prepare in various ways for the test.

In a previous similar study of the analytical section of the test, self-study was found to improve performance on two analytical item types that were subsequently removed from the test. In the present study, no practically significant effects were detected for the verbal, quantitative, or revised analytical sections of the test.

The Impact of Self-Study on GRE Test Performance

Spencer S. Swinton
Donald E. Powers

Most complex issues are seldom resolved to satisfaction when the questions surrounding them are posed in ways that demand absolute answers rather than relative ones. As Messick (1981) and others have contended, the question "Does coaching work?" is one such example, to which an honest but less-than-satisfying response might be "Some coaching works for some of the people some of the time" or more simply "It depends." It depends, for example, on such factors as (a) the nature and duration of the test preparation (Messick & Jungeblut, 1981), (b) the backgrounds of the examinees being prepared (Anastasi, 1976; Dyer, 1953, Stroud, 1980), (c) the particular types of test items that make up the test (Alderman & Powers, 1980; Evans & Pike, 1973, Moore, 1971), and (d) test takers' perceptions of the degree to which the test "counts" (Messick, 1980).

Given these qualifications, and the attendant difficulties involved in designing and implementing research on coaching (Messick, 1980), it is not surprising that no single, "blockbuster" study has resolved the so-called controversy over coaching. More discouraging, however, is that, instead of helping to understand the issues, the various individual studies of coaching have sometimes actually helped to fuel the controversy by seeking unconditional answers to a question that demands more qualified interpretations.

Each of the qualifying factors mentioned previously applies to the GRE General (Aptitude) Test, for which no single, comprehensive study has been attempted. Specifically, we note for factors (a)-(d) that:

(a) A wide variety of test preparation programs and resources are available to GRE test takers. These include, for example, commercially available test preparation books, which examinees can study on their own, and more formal, instructor-based coaching programs offered by undergraduate institutions or by proprietary coaching schools.

(b) As with other tests, the backgrounds of GRE test takers may also come into play, either as variables that moderate the effects of special test preparation (for example, prior test-taking experience) or as factors that underlie candidates' decisions to utilize special preparation (for example, extraordinary motivation).

(c) Because, over the years, the GRE General Test has consisted of from 7 to as many as 11 distinct kinds of test items, it is nesessary, as Novick (1982) has suggested, to conduct analyses for each item type as well as for composite scores. GRE test item types differ not only according to the abilities they are designed to tap, but also according to the particular formats in which they are cast. And

(d) Because the three currently reported GRE scores--verbal, quantitative, and analytical ability--are viewed as differentially important for admission to different fields of graduate study (Powers & Lehman, 1983), test takers may have varying perceptions of the extent to which each of the three scores "count." This may be especially true for the analytical score, which, when this study was undertaken, was accompanied by cautionary remarks and was not yet considered to be fully operational.

Previous GRE-Board-Sponsored Research

Although these factors have prohibited a single, comprehensive study of special test preparation for the GRE General Test, the GRE Board has since 1977 sponsored a number of studies, which in combination have proved useful in shaping GRE program policy on this thorny issue. The Board's efforts have been recognized in the professional literature by Novick (1982), who has cited the GRE program as

> "... the first to give careful attention to the coaching question to the point of modifying testing procedures to reflect research in this area" (p. 9).

Table 1 provides a summary of GRE-Board-sponsored research, categorized by test section and type of test preparation. In general, three distinct kinds of test preparation have been considered in GRE-sponsored research: within-test practice, test familiarization, and coaching.

Within-test practice. Perhaps the most basic has been within-test practice, as studied by Swinton, Wild, and Wallmark (1983). A within-test practice effect is simply improvement in performance on a particular item type because of having encountered items of the same general type earlier in the same test. Swinton et al. (1983) concluded that within-test practice did not appear to improve performance on any of the four verbal items types that are currently used in the GRE General Test or on any of the three quantitative item types. With respect to the four analytical item types used until 1981, they found little evidence of a practice effect for either the logical reasoning or the analytical reasoning item types, which are used in the current version of the test. However, a large within-test practice effect was computed for the analysis of explanations item type (.06 points per item) and a moderate effect for the logical diagrams item type (.04 points per item). These two latter item types were removed from the test in 1981.

Test familiarization. A second kind of test preparation, test familiarization, is typically the sort that test takers can undertake on their own, through self-study of test preparation books or test-sponsor-provided materials designed to acquaint prospective examinees with the test. Over the past few years, major national admission testing programs have tended to provide increasing amounts of preexamination information, including practice tests, for the tests they administer.

While these efforts seem to have been well received by test takers, there has apparently been relatively little impact on test performance, at least for typical test takers on such tests as the Scholastic Aptitude Test (Powers & Alderman, 1983).

Excluding the study reported here, the GRE Board has sponsored one large-scale study of test familiarization, in which Powers & Swinton (1982, 1984) mailed various sets of test preparation materials to samples of GRE test registrants and encouraged randomly selected samples to study the materials. The materials, which were designed only for the analytical portion of the test, included extra practice tests, explanations of correct answers to test questions, and various hints or strategies for approaching each of four analytical item types. A highly significant relationship was found between time spent preparing for the test and GRE analytical scores. The 53-point score advantage for the group that received all preparation materials was due to better performance on the analysis of explanations and logical diagrams item types, but not on either of the two other analytical subtypes. This advantage corresponds to nearly half a standard deviation (SD = 125) on the 200-800 GRE analytical score scale.

Coaching. With respect to the effects of formal coaching programs, Powers (1983) found no significant relationship between examinees' self-reports of the duration of the coaching programs they attended and their GRE verbal scores. Length of coaching program was related significantly ($r = .21$) to effects on the discrete quantitative item type, but not to effects on either of the two other quantitative item types or total quantitative score. Evan's (1977) study of coaching for the GRE quantitative section produced inconclusive results because of severe sample attrition.

Two studies of the effects of coaching on GRE analytical scores by Powers (1983) and Swinton and Powers (1982, 1983) revealed highly significant effects of coaching on analytical scores, again from improved performance on the analysis of explanations and logical diagrams item types. Powers (1983) found strong relationships between self-reported length of analytical coaching programs and test score effects for analysis of explanations ($r = .45$) and for logical diagrams ($r = .35$). Swinton and Powers (1982, 1983) found a highly significant effect on analytical scores (66 points) of a special preparation program developed and offered by the authors. Again effects resulted from better performance on analysis of explanations and logical diagrams items.

As is clear from Table 1, some information is available for seven of the nine categories listed. The only areas for which no data exist apparently are test familiarization for the verbal and quantitative sections of the test. The study reported here was designed to provide some information relative to these two categories.

Table 1

Summary of GRE-Board-Sponsored Studies Related to Preparation

Test Section	Type of Test Preparation: Within-Test Practice	Test Familiarization	Coaching
Verbal	Swinton, Wild, & Wallmark (1983) found that within-test practice did not affect performance on any of the verbal item types used in the test. Kingston & Dorans (1982) analysis of the same data resulted in similar conclusions.		Powers (1983) found no significant relationships between length of coaching programs and effects on GRE verbal scores or item types.
Quantitative	Swinton, Wild, & Wallmark (1983) and Kingston & Dorans (1982) concluded that within-test practice did not appear to affect performance on any of three GRE quantitative item types.		Powers (1983) found no significant relationships between length of coaching programs and effects on GRE quantitative total scores, but length of program was related moderately to effects on the discrete quantitative item type. Evans (1977) study produced inconclusive results because of severe sample attrition.
Analytical	Swinton, Wild, & Wallmark (1983) found a large within-test practice effect for analysis of explanations items and a moderate effect for logical diagrams. There was little evidence of a practice effect for either the logical reasoning or the analytical reasoning item types. Kingston & Dorans (1982) reanalysis supported these conclusions.	Powers & Swinton (1982, 1984) found a strong relationship between time spent using self-familiarization materials and GRE analytical scores. A significant test score advantage was noted for examinees who received and used all of the available test preparation materials. Effects stemmed from improvements on analysis of explanations and logical diagrams item types, but on neither of the other two item types.	A special preparation course designed and administered by Swinton & Powers (1982, 1983) for the analytical section had a highly significant effect on GRE analytical scores. Test score improvements resulted from better performance on analysis of explanations and logical diagrams items, but neither of the other two item types. Powers (1983) noted similar effects when studying the relationships between length of coaching program and effects on analytical scores: performance on both analysis of explanations and logical diagrams was strongly related to length of coaching program.

Objectives

The major objective of the study was to estimate the effects on GRE verbal and quantitative scores, and on individual item type performance, of using various combinations of test familiarization materials designed for these test sections.

A second objective was to reassess the effects of test familiarization for the revised analytical measure of the test, which no longer contained the two item types found previously to be susceptible to coaching and practice. This reassessment seemed desirable in part because in the previous studies the test practice that was provided tended to be proportional to the percentages of each item type in the test. Because they comprised a relatively small portion of the original analytical measure, less test practice was provided for the two remaining analytical item types than for the two types that have been removed from the test. Hence, the study reported here enabled a somewhat better determination of the effects of test familiarization for the two item types that are used in the current version of the test.

A third and final objective was to determine more precisely the nature of any effect on one quantitative item type, quantitative comparisons, which has been shown to be susceptible to improvement in the SAT (Evans & Pike, 1973). Specifically, we wished to assess the degree to which any improvement in performance on this item type was due to improvement in the mathematical skills and knowledge tested by these items, or simply to increased facility with the item format.

Method

In the fall of 1981, the GRE program made available to all test takers an expanded version of the GRE Information Bulletin, which contained additional information on test preparation strategies and a review of mathematical concepts. Besides the full-length practice test included in the Bulletin, an additional full-length test was also available for a slight fee to all prospective test takers.

The availability of these materials to all GRE test takers provided the opportunity to apply the same kind of "encouragement design" that was used in a previous study of the original analytical measure (Powers & Swinton, 1982, 1984). The GRE Information Bulletin was dissected and various parts that emphasized particular aspects of test preparation were reassembled as discrete packages. All information pertaining to a particular portion of the test--verbal, quantitative, or analytical--was packaged separately. Further, within each test section the discussion of various strategies was separated also. For instance, all information that pertained to rate of work on the test (for example, pacing strategies and instructions to learn test directions ahead of time in order to save time on the test) was assembled separately for each test section. Information on strategies for approaching each item type, explanations of answers to sample questions, and the review of mathematical concepts were also packaged separately, as were both the sample test included in the Bulletin and the disclosed test.

Appendix A contains examples of the test-taking strategies booklets, for which information was obtained directly from the GRE Information Bulletin. Marginal notes were intended to highlight certain important points made in the materials and to provide further encouragement to prepare for the test. Appendix B contains the suggestions that pertained to rate of work on the test. Again, these suggestions, each of which appears in the Bulletin, were highlighted with marginal comments. The same set of suggestions was given for each test section, since they applied equally well. Appendix C contains the separate printing of the review of mathematical concepts that is included in the Bulletin. Underlining was used to highlight key points, and comments were provided to help clarify some concepts. Appendix D contains a reprint of the verbal portion of the sample test that is included in the Bulletin. Additional reprints were available for each of the other portions of the test, and three similar additional booklets were based on a disclosed form of the GRE General Test.

The basic study design is shown in Table 2. The two major experimental factors were (a) material sent to candidates and (b) the particular kind of encouragement provided. The control group did not receive any special preexamination information, although they did of course have access to all of the materials provided to the other samples in the study.

Random samples of candidates were selected, in the numbers shown in Table 2, from the pool of test-takers who registered at least seven weeks before the test administration. As in previous studies, the use of early registrants was necessary to ensure that test takers received the materials in time to use them in their preparation for the test.

As shown in Table 2, not all groups of test takers were encouraged to use the materials they were sent. Materials were transmitted to some groups with only a noncommittal letter. For those who were encouraged, encouragement consisted of the materials plus a strongly worded letter of encouragement to use the materials. Three different versions of the letter were developed, each emphasizing the importance of test preparation by including either (a) brief summaries of research results that showed positive effects of preparation on test scores, (b) testimonials from examinees who had used the preparation materials offered in previous studies, or (c) accounts of the efficacy of special test preparation as found in the popular press. (See Appendix E for examples of each kind of letter.) No separate analysis was attempted here for these various encouragement emphases.

Immediately after the test administration, all test candidates in the study were surveyed by mail to determine if they had used the materials and, if so, in what manner and to what extent. Control group examinees were also asked to indicate how much time they had devoted to preparing for each portion of the test and to particular facets of test preparation, for example, reviewing math, taking practice tests, and learning test-taking strategies. Nonrespondents were followed up approximately three weeks after the initial mailing. Test scores and additional background data that are provided by all test registrants were retrieved from GRE candidate files.

Table 2

Treatment Group Codes, Numbers of Subjects, and Treatment

Group	n	Materials	Encouragement
000	1000	none	none
011	200	Verbal Test B	none
012	200	Quantitative Test B	none
013	200	Analytical Test B	none
101	200	Verbal Test A	Verbal Strategies
102	500	Quantitative Test A	Quantitative Strategies
103	200	Analytical Test A	Analytical Strategies
111	200	Verbal Tests A & B	Verbal Strategies
112	500	Quantitative Tests A & B	Quantitative Strategies
113	200	Analytical Tests A & B	Analytical Strategies
201	200	Verbal Test A	Verbal Speed
202	500	Quantitative Test A	Quantitative Speed
203	200	Analytical Test A	Analytical Speed
211	200	Verbal Tests A & B	Verbal Speed
212	500	Quantitative Tests A & B	Quantitative Speed
213	200	Analytical Tests A & B	Analytical Speed
302	500	Quantitative Test A	Quantitative Review
312	500	Quantitative Tests A & B	Quantitative Review

Test A is a reprint of the practice test section in the GRE Information Bulletin.

Test B is a disclosed form of the test.

To determine the nature of any effects of test preparation on test takers' performance on the quantitative comparisons item type, a regular multiple-choice math test was developed, which entailed changing the quantitative comparisons format to a five-choice regular math test. This test was spiraled in the unscored pretest section of the operational test. The spiralling was such that about one in every ten examinees would take this experimental test, which paralleled the content (e.g., inequalities and estimation problems) of the quantitative comparisons items in the operational test. Because the tests differed only in the item formats used, improvements on one but not the other would implicate item format, but not content, as the source of improvement.

Multivariate analysis of covariance was employed to estimate treatment effects with verbal, quantitative, and analytic scores as dependent variables for all subjects. The analyses were repeated for the subset of subjects who had returned questionnaires, with test scores as dependent variables, and with self-reported preparation time as independent variables.

Multivariate analysis of covariance allowed the simultaneous analysis of treatment effects for our correlated outcome variables, that is, test scores on each measure in the test. The use of covariates (background variables such as sex, age, and undergraduate grade point average) enabled increased precision and partial adjustments for differences in cell means attributable to sampling variation. The SPSS Manova program (Hull & Nie, 1981) was used in the analyses reported here.

Results

Of the 6,200 early registrants sampled for the study, 5,119 took the GRE General Test. A total of 4,856 of these test takers responded to the background questions that are asked of all test registrants. This sample was the base for the overall analysis of effects of the treatment on test scores. A total of 4,340 test takers responded to the test preparation questionnaire that was developed for this study, and 3,946 of these had complete data on the amount of time spent preparing for the test as well as test scores and background data. This latter group, which was almost 78 percent of those who took the test, was used to analyze the effects of the treatment on time spent preparing and on test scores. Table 3 shows the number of subjects included in each cell of the analyses.

Table 3

Actual Numbers of Subjects

Encouragement: Verbal

Encouragement:		None	Strategies	Speed
Additional practice test	no	785(652)*	160(114)	164(133)
	yes	146(116)	163(130)	150(113)

Encouragement: Analytical

Encouragement:		None	Strategies	Speed
Additional practice test	no	785(652)*	163(122)	133(104)
	yes	165(142)	149(129)	170(133)

Encouragement: Quantitative

Encouragement:		None	Strategies	Speed	Review
Additional practice test	no	785(652)*	397(324)	419(347)	371(307)
	yes	164(141)	372(303)	381(307)	404(329)

*The control group is the same group in each subtable.

Note. Numbers in parentheses indicate the numbers of examinees for whom test scores, background data, and test preparation questionnaires were available.

Full sample: verbal, quantitative and analytical scores.

A multivariate analysis of covariance was performed in a crossed two-way design with encouragement (E) and treatment (T) as factors. Sex, age, undergraduate major, undergraduate grade point average, ethnicity, and degree objective, as reported by examinees on their registration forms, were used as covariates. The use of covariates improved precision considerably, accounting for 21 percent of the variance in verbal scores, 23 percent of the variance in analytical scores, and 36 percent of the variance in quantitative scores. For verbal encouragement, observed cell means of test scores are given in Table 4.

Table 4

Observed Means, Verbal Encouragement
Total n = 1568

Encouragement:			None	Strategies	Speed
Additional practice test	no	V:	489.3	491.3	486.2
		Q:	520.6	526.7	498.9
		A:	509.1	514.2	502.6
	yes	V:	501.2	489.5	487.9
		Q:	527.2	499.0	492.3
		A:	527.0	489.8	490.7

The significance of the multivariate test of significance (Wilks' lambda) for each effect is given in Table 5. Univariate and step-down F tests confirmed the absence of any treatment effect significant at the .05 level.

Table 5

Multivariate Test of Significance, Verbal Encouragement

Effect	Wilks's lambda	Hypothesis d.f.	Error d.f.	F	p
E by T	.995	6	3102	1.31	.249
T	.998	3	1551	.99	.395
E	.996	6	3102	1.12	.349

For quantitative encouragement, the observed cell means are given in Table 6. Standard deviations ranged from 111 to 140. Again, the covariates were effective in increasing precision, accounting for 41 percent of the variance in quantitative scores, 26 percent of the variance in analytical scores, and 23 percent of the variance in verbal scores.

Table 6

Observed Means, Quantitative Encouragement
Total n = 3293

Encouragement:			None	Strategies	Speed	Review
Additional practice test	No	V:	489.3	501.3	490.7	500.3
		Q:	520.6	528.1	514.3	526.3
		A:	509.1	510.3	514.7	517.0
	Yes	V:	500.4	480.6	498.6	490.4
		Q:	523.3	520.4	518.8	517.1
		A:	522.5	511.0.	508.5	511.8

Table 7 gives the values of the multivariate tests of significance for each effect in the design.

Again, no univariate tests reached the .10 significance level, although the step-down test for quantitative scores, entered after verbal and analytical scores yielded a probability of .056 for the effect of encouragement.

Table 7

Multivariate Test of Significance, Quantitative Encouragement

Effect	Wilks's lambda	Hypothesis d.f.	Error d.f.	F	p
E by T	.996	9	7968	1.54	.127
T	.999	3	3274	.60	.613
E	.997	9	7968	1.10	.356

For analytical encouragement, observed cell means are given in Table 8. Standard deviations ranged from 111 to 142. Covariates accounted for 39 percent of the variance of quantitative scores, 25 percent of the variance of analytical scores, and 23 percent of the variance of verbal scores.

Table 8

Observed Means, Analytical Encouragement
Total n = 1565

Encouragement			None	Strategies	Speed
Additional practice test	No	V:	489.3	482.9	500.6
		Q:	520.6	496.9	511.2
		A:	509.1	494.8	514.9
	Yes	V:	475.2	497.4	488.5
		Q:	507.9	517.1	509.5
		A:	498.2	522.8	518.1

Table 9 gives the value of the multivariate tests of significance for each effect in the design.

The univariate test for the effect of encouragement on analytical scores had a p-value or significance level of .079, and the stepdown test, entering analytical scores after allowing for effects on verbal and quantitative scores, had probability .02. No other univariate or step-down test yielded a probability less than .10.

Table 9

Multivariate Tests of Significance, Analytical Encouragement

Effect	Wilks's lambda	Hypothesis d.f.	Error d.f.	F	p
E by T	.996	6	3096	1.09	.369
T	.997	3	1548	1.43	.233
E	.993	6	3096	1.77	.101

The results of these analyses suggest that encouragement to study did not have a signficant overall effect on GRE verbal or quantitative scores, but that the effect on analytical scores, although not reaching statistical significance, may warrant further investigation.

Does this allow us to conclude that self-study has no impact on these scores? Not quite. The treatment consisted of encouragement to study. The results reported above are consistent with no significant effect of preparation, but they would also be expected if encouragement to prepare had not worked, and the encouraged groups had not in fact prepared any more than the control group. To rule out this alternative explanation, we must determine whether or not the treatment influenced preparation time.

Although this determination could not be made for the entire sample, it could be made for an impressively large proportion of the test takers who returned questionnaires, reporting the time they spent preparing for each section of the test, and the types of preparation in which they engaged. This somewhat smaller group can be used to estimate the effects of encouragement on preparation time. If a large effect of treatment on time spent in preparation is observed, we cannot be certain, however, that the effect was as large in the 20 percent of test takers who did not respond. However, if the effect is highly significant in this large subsample, it becomes at least plausible that the treatment had the desired effect on preparation time in the entire group.

Questionnaire Respondents: Time Spent in Preparation

Multivariate analyses of covariance, using the same covariates employed in the full sample, were performed in the subsamples returning questionnaires for each type of encouragement. Dependent variables were responses to seven questions concerning preparation time, as follows:

1. About how much time did you spend on each of the following activities in preparation for the GRE Aptitude Test?

   A Reviewing math

   B Taking practice tests

   C Building up speed in answering questions

   D Learning test-taking strategies

2. In total, how much time did you spend preparing for each section of the test?

   A Verbal

   B Quantitative

   C Analytical

Table 10 gives means for self-reported time in verbal, quantitative, and analytical test preparation for the verbal encouragement group.

Table 10

Mean Preparation Times in Hours, Verbal Encouragement

Encouragement			None	Strategies	Speed
Additional practice test	No	V:	2.67	3.61	3.02
		Q:	2.68	3.50	3.13
		A:	2.11	2.76	2.72
	Yes	V:	3.06	3.47	2.88
		Q:	2.94	3.30	2.37
		A:	2.29	2.44	1.83

Inspection of these means suggests that with or without encouragement, candidates spent less time preparing for the analytical test than for the verbal and quantitative tests, that strategies encouragement was associated with more preparation time for all sections, but that the speed encouragement was not effective. Additional practice tests appear to have less effect on time. The analysis of covariance (Table 11) confirms that the encouragement effect was significant.

Table 11

Multivariate Analysis of Covariance
Time Spent in Preparation: Verbal Encouragement
n = 1,258

Effect	Wilks's lambda	Hypothesis d.f.	Error d. f.	F	p
E by T	.984	14	2474	1.45	.121
T	.991	7	1237	1.54	.149
E	.973	14	2474	2.43	.002

The univariate F for the effect of encouragement on time spent in preparing for the verbal section was significant beyond the .001 level. Univariate F tests for learning test-taking strategies, taking practice tests, and preparing for the quantitative test were significant beyond the .01 level, and for time spent in reviewing mathematics beyond the .02 level.

For time spent in preparing for the verbal test, the contrast between no encouragement and the mean of the two encouragement treatments was .35 hours, ($p < .05$) and between strategy and speed encouragement, .61 hours ($p < .01$). The contrast for all encouragement vs. no encouragement was not significant for time spent preparing for the quantitative test, but the

contrast in time between strategies and speed verbal encouragement was comparable to that observed for time spent in preparing for the verbal test. Although the multivariate test was not significant, the low reported time preparing for the analytical test among those who received verbal encouragement and an additional verbal practice test led to a significant univariate F for the E by T effect for preparation time on the analytical test.

Thus, encouragement to practice test-taking strategies had the desired significant effect on time spent in preparing for the verbal test. This effect also spilled over to other test preparation activities and to preparation for the quantitative test. Encouragement emphasizing building up speed had significantly less effect on time spent in preparation than did encouragement that emphasized strategies.

Table 12 gives mean times for questionnaire respondents receiving quantitative encouragement.

Table 12

Mean Preparation Times in Hours, Quantitative Encouragement

Encouragement			None	Strategies	Speed	Review
Additional practice test	No	V:	2.67	2.70	2.70	2.57
		Q:	2.68	3.28	3.08	3.01
		A:	2.11	2.42	2.38	2.12
	Yes	V:	2.78	2.61	2.74	2.83
		Q:	2.98	3.19	3.23	3.46
		A:	2.43	2.38	2.41	2.63

Inspection of the means suggests that quantitative encouragement had considerable effect on time spent preparing for the quantitative test. Analysis of covariance (Table 13) confirms this suggestion.

Table 13

Multivariate Analysis of Covariance
Time Spent in Preparation: Quantitative Encouragement

Source	Wilks's lambda	Hypothesis d.f.	Error d.f.	F	p
E by T	.992	21	7716	1.01	.447
T	.997	7	2687	1.21	.295
E	.975	21	7716	3.25	.000

Univariate tests were significant for time preparing for the quantitative test ($p = .001$), for time learning test-taking strategies ($p = .014$), and for time reviewing mathematics ($p = .02$). They were not significant for any of the other four time variables.

Quantitative encouragement thus had a significant effect, increasing time spent in preparing for the quantitative section, with no spill-over effect on time spent preparing for the other two sections. The contrast of nonencouraged vs. mean of all encouraged groups, .36 hours, was significant at the .002 level.
Table 14 gives mean times spent in preparation by questionnaire respondents who received analytical encouragement.

Table 14

Mean Preparation Times in Hours,
Analytical Encouragement
n = 1282

Encouragement			None	Strategies	Speed
Additional practice test	No	V:	2.67	3.08	2.57
		Q:	2.68	3.22	2.95
		A:	2.11	3.13	2.68
	Yes:	V:	2.57	2.58	3.07
		Q:	2.79	3.01	2.96
		A:	2.33	3.10	2.79

Inspection of the means suggests that analytical encouragement succeeded in bringing the time devoted to preparation for the analytical section up to levels comparable to those for the other two sections for which no encouragement was given. Table 15 shows that this effect was significant.

Table 15

Multivariate Analysis of Covariance
Time Spent in Preparation: Analytical Encouragement

Source	Wilks's lambda	Hypothesis d.f.	Error d.f.	F	p
E by T	.978	14	2522	1.996	.015
T	.986	7	1261	2.48	.016
E	.946	14	2522	5.07	.000

Univariate tests show that significant interaction is due to time spent in learning test-taking strategies ($p = .023$), highest for strategies encouragement with no additional practice test, with an almost significant contribution to interaction ($p = .056$) from time spent preparing for the verbal test (relatively low for speed encouragement with no practice test and for strategies encouragement with a practice test). Time spent in preparing for the analytical test did not contribute to this interaction, with a univariate F of .205 ($p = .815$).

The significant effect of receiving an additional practice test was confined to time spent taking practice tests (step-down $F = 9.30$ $p = .002$) after time reviewing mathematics had been entered. No univariate F test was significant, and no univariate or step-down F test was significant for total time preparing for each of the three tests.

The encouragement effect, however, was pronounced and targeted to activities associated with the analytical test. Univariate F statistics were 17.84 ($p = .001$) for time spent in preparing for the analytical section, 5.81 ($p = .003$) for time spent learning test-taking strategies, and 3.07 ($p = .047$) for time taking practice tests. No other univariate F statistics approached significance. The contrast in analytical preparation time between the nonencouraged groups and the mean of the encouraged groups, .71 hours, was significant beyond the .001 level. Analytical encouragement had a greater effect than verbal or quantitative encouragement, perhaps because it increased time from a lower base.

Without encouragement, examinees reported spending 2.57 to 2.79 hours in preparing for the verbal and quantitative sections of the test, but only 2.11 to 2.33 hours in preparing for the analytical sections. With analytical encouragement, analytical preparation time rose to from 2.66 to 3.15 hours, comparable to time spent in preparing for the other two measures. If the analytical measure had been fully operational*, one would expect candidates to spend as much time preparing for it as for the other two measures.

Thus, in each case encouragement significantly increased self-reported preparation time for the particular portion of the test at which encouragement was directed. Even if we were to assume no effect on time for the nonrespondents, mean preparation time for all subjects would still be greater in the encouraged than in the nonencouraged groups. We may thus rule out the hypothesis that encouragement had no effect on preparation time. This leaves us with the conclusion that increased preparation time did not lead to significant effects on either verbal or quantitative test scores.

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*

When this study was conducted, the analytical measure was considered to be experimental, and test score users were cautioned not to rely on analytical scores until further study of the validity of these scores could be undertaken. In the fall of 1985 the analytical measure will become a fully operational partner with the verbal and quantitative measures.

Would further increases in preparation time beyond three hours replicate the marginally significant results obtained here for analytical scores, or would they reach a point of diminishing returns and yield nonsignificant results comparable to those observed for verbal and quantitative scores for additional increments in study time? These data do not provide an answer to this question. Indeed, without the higher baseline time that would result for the fully operational analytical measure, it is not clear that even a more effective treatment than the encouragement and additional practice test employed here would provide an unequivocal answer. The fact that additional time spent in preparing for the analytical test is marginally effective in increasing test scores only if an additional practice test is available does suggest that candidates are not yet as familiar with analytical as with verbal and quantitative item formats. Although mean times for all students may have been slightly lower than mean times for questionnaire respondents (test scores were lower by 3 to 12 points), it is reasonable to assume that this relationship is monotonic: Cells with higher self-reported mean times had higher overall mean times. We may thus examine the relationship between mean time and mean score for each measure in the test, and compare these relationships with those found in the previous study (Powers & Swinton, 1982, 1984).

Figure 1 shows the mean verbal score plotted against mean preparation time for each cell in the verbal encouragement substudy. It gives no evidence of a relationship between preparation time and verbal test scores. Figure 2 shows the corresponding plot of mean quantitative scores vs. quantitative preparation time. Likewise, this plot gives no evidence of a relationship. Figure 3 shows analytical scores plotted against analytical preparation time in the analytical encouraged groups. Though not significant, an interaction is suggested, in which encouraged examinees who also received an additional practice test scored higher than other groups.

In contrast, Figure 4 reproduces the plot of mean analytical score vs. preparation time from the earlier study of the original analytical measure (Powers & Swinton, 1982, 1984), which contained two item types that were shown to be susceptible to short-term preparation and are not included in the revised analytical measure studied here. As shown in Figure 4, a one hour increase in preparation time was associated with a score increase of about 30 points. No such relationship is apparent in the present data for the revised test.

Finally, as stated earlier, the third objective of the study was to determine more precisely the nature of any effects on the quantitative comparisons item type. Because, however, no effects were detected for quantitative performances, these more precise analyses were not conducted.

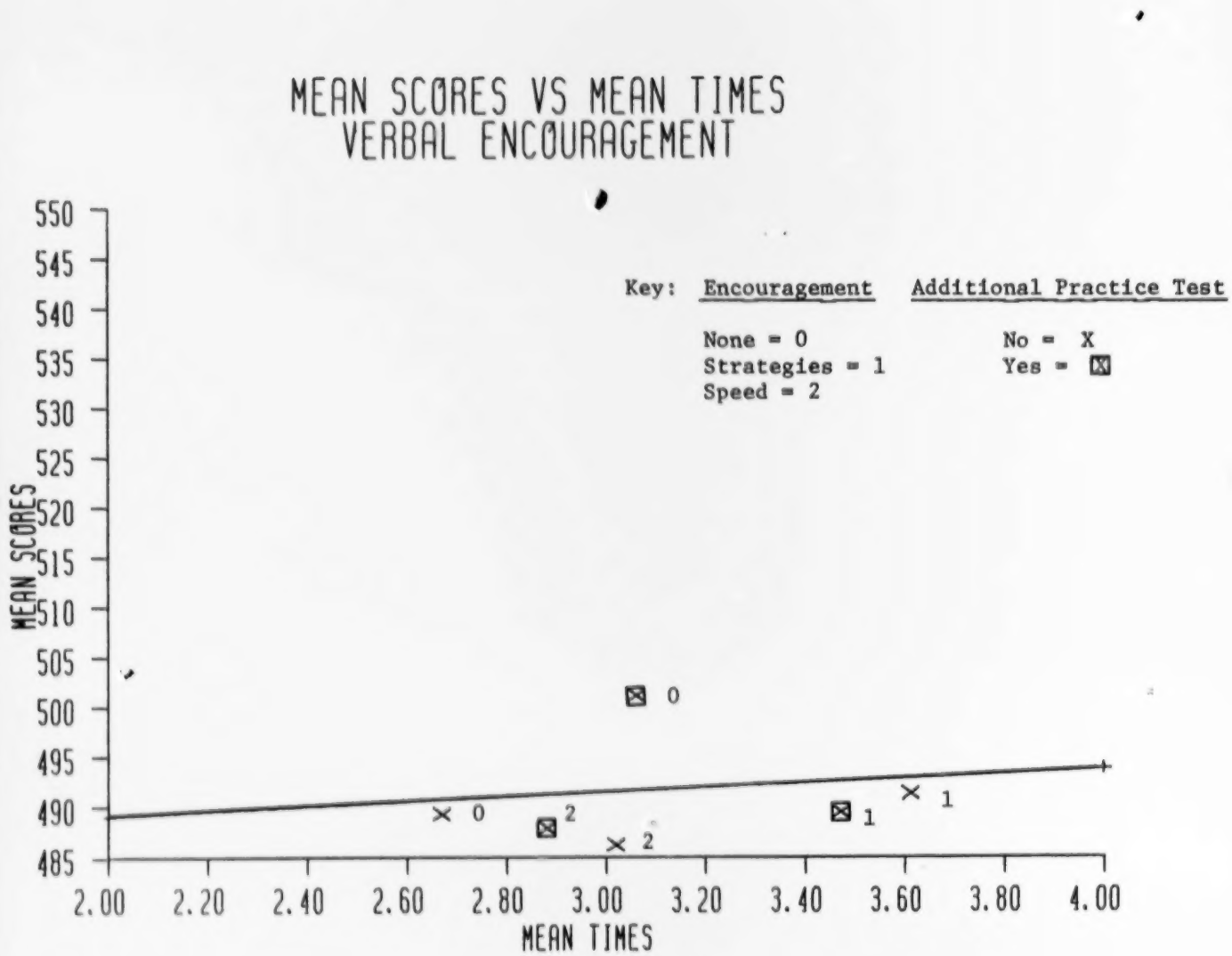

Figure 1. Regression of GRE verbal mean scores on mean hours of verbal test preparation for six treatment groups.

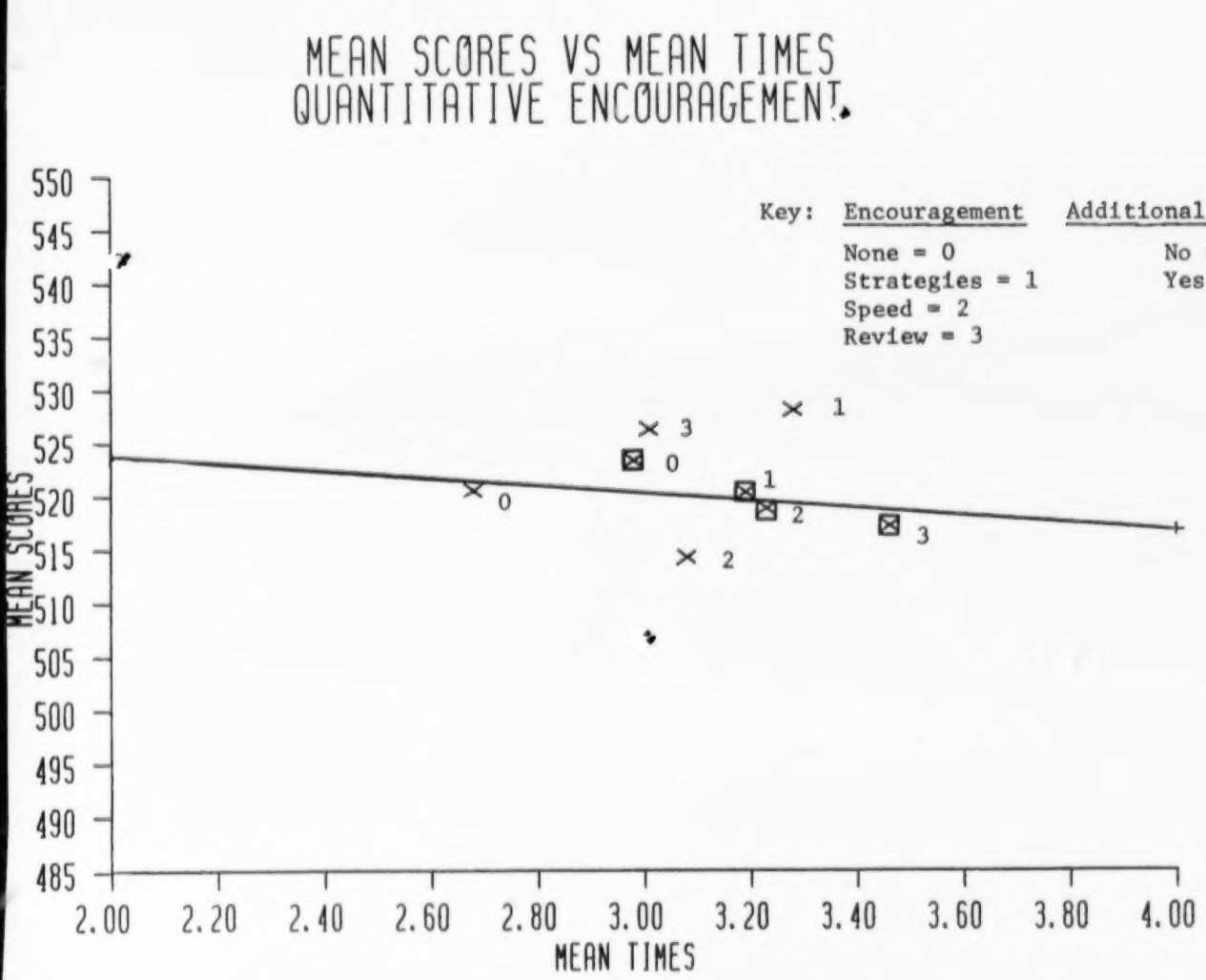

Figure 2. Regression of GRE quantitative mean scores on mean hours of quantitative test preparation for eight treatment groups.

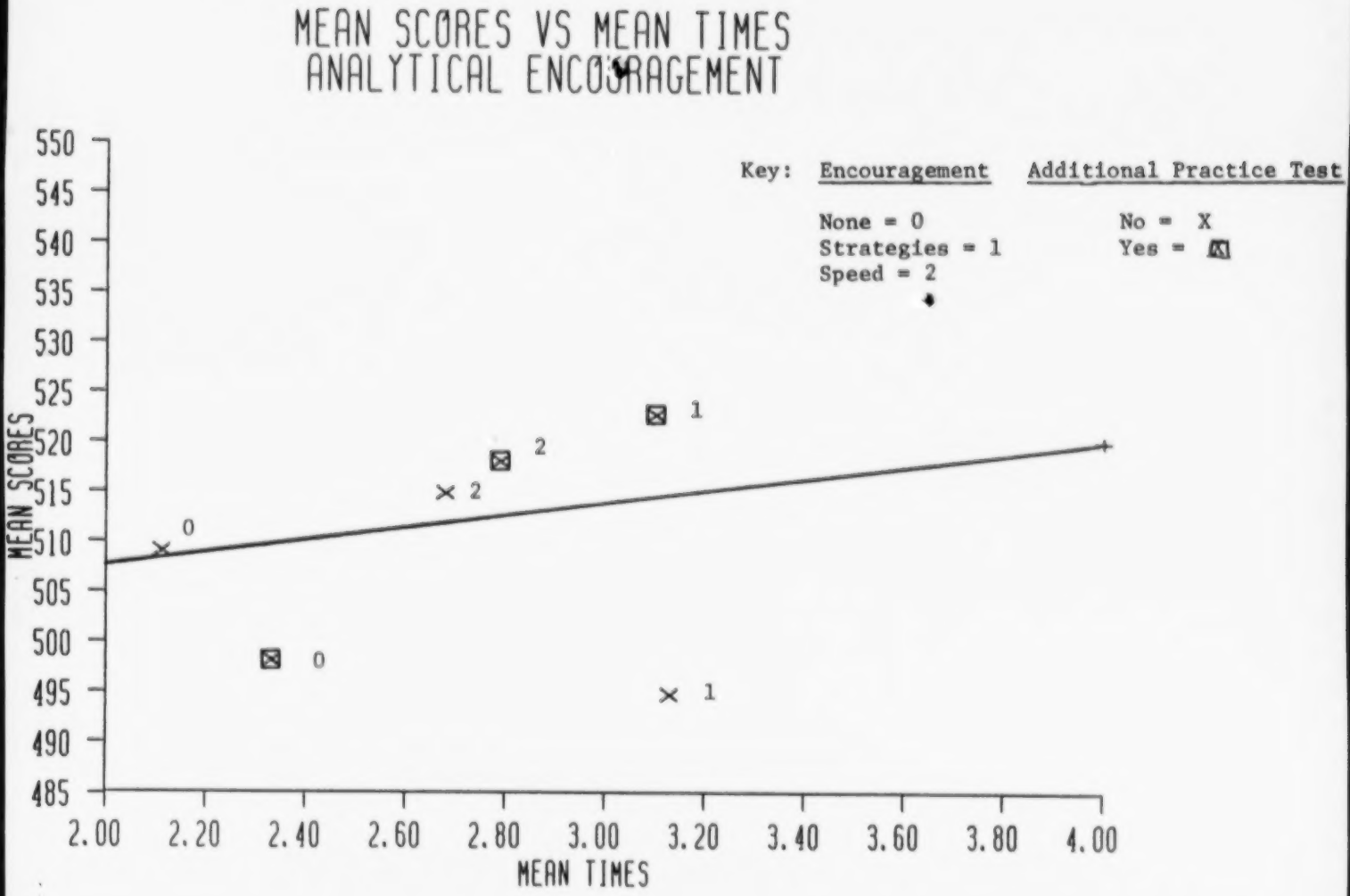

Figure 3. Regression of GRE analytical mean scores on mean hours of analytical test preparation for six treatment groups.

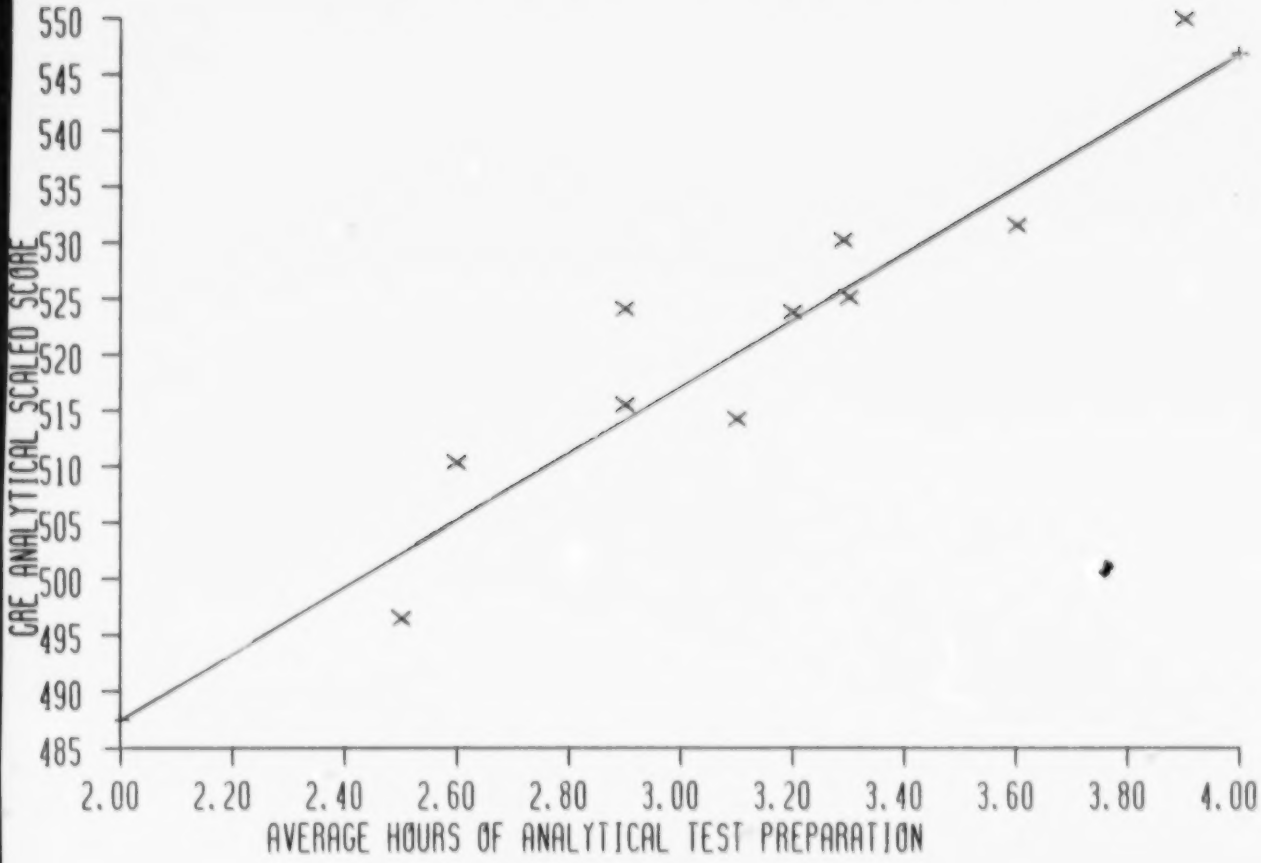

Figure 4. Relationship of average GRE anaytical scaled scores to average time spent in preparation.

Summary and Discussion

Over the past five years, the GRE Board has sponsored a number of studies aimed at determining the susceptibility of the General (Aptitude) Test to various kinds of special test preparation. In addressing the effects of (a) within-test practice, (b) self-test-familiarization, and (c) instructor-based "coaching," these studies have provided some information for each of the three sections of the GRE General Test. The only exception is that up to now no data were available regarding self-test-familiarization for the verbal or quantitative sections of the test. The study reported here was undertaken to help fill this information gap, as well as to provide data on the effects of test familiarization for the revised analytical section.

The results suggest that, for the verbal and quantitative sections of the test, additional test familiarization activity beyond that normally undertaken by typical GRE test takers will probably not result in higher test scores. We emphasize that this conclusion applies only to typical examinees who engage in some preexamination preparation and only to effects on test scores. Additional test familiarization may result in improved self-confidence and decreased anxiety even though, on average, test scores may not improve. Powers and Alderman (1983) reported this state of affairs for the Scholastic Aptitude Test (SAT), and comments provided by many GRE test takers in this study suggest that these outcomes are likely for the GRE General Test too.

The same conclusion was drawn for the revised analytical section of the GRE General Test, although more tentatively. Comparing the relationships between time spent preparing for the test and average test scores for the original and revised versions of the analytical measure showed that the current version does not exhibit the extreme susceptibility to self-test-familiarization that was characteristic of the original measure. It is important to note that the same encouragement design employed in this study had detected large effects for the original measure (Powers & Swinton, 1982, 1984). For the current analytical measure, we found no significant relationship between test preparation and test score. However, because the analytical measure was, at the time this study was conducted, not completely operational, there are lingering questions about the extent to which, in the minds of examinees, this portion of the test "counted." As noted earlier, this perception may have affected examinees' motivation, which in turn could moderate the effectiveness of special test preparation. It was noted in fact that unencouraged examinees spent considerably less time preparing for the analytical measure than for the other two parts of the test. Because the results were "nearly significant" statistically, we are reluctant to conclude that test familiarization or other kinds of special test preparation will not have any impact on scores on the analytical measure, which in October 1985 will be fully operational. Nonetheless, we are relatively confident that extreme susceptibility to special test preparation is not a prominent characteristic of the revised analytical measure, as it was for the original measure.

In conclusion, we can now fill in the missing sections of Table 1 with the following information:

> Swinton and Powers (1984) found no significant relationships between the amount of time spent using self-familiarization materials and scores on either the verbal or the quantitative sections of the GRE General Test. The same finding applied to the revised analytical portion of the test, which was not yet fully operational when the study was conducted.

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Appendix A

Test-Taking Strategies for Each Section of the Test

GRE
GRADUATE RECORD EXAMINATIONS

TEST-TAKING STRATEGIES FOR THE VERBAL SECTION OF THE GRE APTITUDE TEST

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Verbal Ability

The verbal ability measure is designed to test one's ability to reason with words in solving problems. Reasoning effectively in a verbal medium depends primarily upon the ability to discern, comprehend, and analyze relationships among words or groups of words and within larger units of discourse such as sentences and written passages. Such factors as knowledge of words and practice in reading will, of course, define the limits within which one can reason using these tools.

The verbal measure consists of four question types: analogies, antonyms, sentence completions, and reading comprehension sets. The examples of verbal questions in this section do not reflect precisely the difficulty range of the verbal measure. A greater number of difficult questions than would be encountered in the test have been included to provide practice in approaching more complex verbal questions.

ANALOGIES

Analogy questions test the ability to recognize relationships among words and the concepts they represent and to recognize when these relationships are parallel. The process of eliminating four wrong answer choices requires one to formulate and then analyze the relationships linking six pairs of words (the given pair and the five answer choices) and to recognize which answer pair is most nearly analogous to the given pair. Some examples of relationships that might be found in analogy questions are kind, size, contiguity, or degree.

Some approaches that may be helpful in answering analogy questions:

- Before looking at the answer choices, try to establish a precise relationship between the words in the given pair. It is usually helpful to express that relationship in a phrase or sentence; for example, the relationship between the word pair THRIFTY : MISERLY could be expressed as "to be *miserly* is to be *thrifty* to an excessive degree." Next, look for the answer choice with the pair of words whose relationship is closest to that of the given pair and can be expressed in a similar fashion.

First, state the relationship in your own words. Then look for it among the choices.

- Occasionally, more than one of the answer choices may seem at first to express a relationship similar to that of the given pair. Go back to the given pair and try to state the relationship more precisely or identify some aspect of the relationship between the given pair of words that is paralleled in only *one* answer choice pair.

Sometimes more precision is needed.

- Remember that a single word can have several different meanings. If you are unable to establish a relationship between the given pair or to find a parallel relationship among the answer choice pairs, check to be sure you have not overlooked a possible second meaning for one of the words.

Don't let words with several meanings fool you.

- *Never* decide on the best answer without reading *all* the answer choices. If you do not read all the answer choices, you may miss an answer choice that would have appeared superior to the choice you made or might have prompted you to reevaluate your understanding of the question.

Read all the choices.

- Practice recognizing and formulating relationships between word pairs. You can do this with the following sample questions and with the analogy questions in the sample test in this booklet.

Directions: **In each of the following questions, a related pair of words or phrases is followed by five lettered pairs of words or phrases. Select the lettered pair that best expresses a relationship similar to that expressed in the original pair.**

1. COLOR : SPECTRUM : : (A) tone : scale
(B) sound : waves (C) verse : poem
(D) dimension : space (E) cell : organism

The relationship between *color* and *spectrum* is not merely that of part to whole, in which case (E) or even (C) might be defended as correct. A *spectrum* is made up of a progressive, graduated series of colors, as a *scale* is of a progressive, graduated sequence of tones. Thus, (A) is correct. Here, the best answer must be selected from a group of fairly close choices; this question is of medium difficulty.

2. ABDICATION : THRONE : : (A) paradox : argument
(B) competition : match (C) defeat : election
(D) bequest : will (E) resignation : office

This question is quite easy because the relationship between *abdication* and *throne* is easy to perceive and because only the correct answer, (E), expresses a similar relationship. (C) is incorrect because *defeat* is not voluntary, as are *abdication* and *resignation* and because *election*, the process of attaining a particular status, is not parallel to *throne* and *office*.

3. RAFT : CONVEYANCE : : (A) speech : conversation
(B) pistol : assassination (C) buoy : demarcation
(D) detective : surveillance (E) yacht : elegance

A *raft* is an example of or means of accomplishing *conveyance*. The answer to this difficult question is (C); a *buoy* is an example of or means of accomplishing *demarcation*. Answering this question involves a close analysis of other answer choices, particularly (A) and (B). *Speech* is necessary for *conversation* (choice A), whereas a *raft* is one of many examples of *conveyance; speech* has important functions other than *conversation*, whereas *conveyance* is the primary function of a *raft*. Choice (B) is more difficult to eliminate since, at first, it seems to parallel the relationship between *raft* and *conveyance*, that is, a *pistol* is an object by means of which an *assassination* can be accomplished. A comparison of choices (B) and (C) reveals, however, that (C) is the more precise analogy since a *pistol* is not an example of *assassination*. Also, a *pistol* has primary functions other than *assassination*, whereas the primary function of a *raft* is *conveyance*.

4. HEADLONG : FORETHOUGHT : :
(A) barefaced : shame (B) mealymouthed : talent
(C) heartbroken : emotion (D) levelheaded : resolve
(E) singlehanded : ambition

The considerable difficulty of this question probably derives primarily from the complexity of the relationship between *headlong* and *forethought* rather than from any inherent difficulty in the words. Analysis of the relationship between *headlong* and *forethought* reveals the following: an action or behavior that is *headlong* reveals lack of *forethought*. Only answer choice (A) displays the same relationship between its two terms.

ANTONYMS

Although antonym questions test knowledge of vocabulary more directly than do any of the other verbal question types, the purpose of the antonym questions is to measure not merely the strength of one's vocabulary but also the ability to reason from a given concept to its opposite. Antonyms may require only rather general knowledge of a word or they may require one to make fine distinctions among answer choices. Antonyms are generally confined to nouns, verbs, and adjectives; answer choices may be single words or phrases.

Some approaches that may be helpful in answering antonym questions:

- Remember that you are looking for the word that is the most nearly *opposite* to the given word; you are *not* looking for a synonym. Since many words do not have a precise opposite, you must look for the answer choice that expresses a concept *most nearly* opposite to that of the given word. For this reason, antonym questions are not measures of rote vocabulary knowledge; rather, these questions ask you to evaluate shades of meaning and the interaction of meaning between words.

Remember, opposite, not same.

They don't all have exact opposites.

- In some cases more than one of the answer choices may appear at first to be opposite to the given word. Questions that require you to make fine distinctions among two or more answer choices are best handled by defining more precisely or in greater detail the meaning of the given word.

Some require more precision than others.

- It is often useful, in weighing answer choices, to make up a sentence using the given word; if you do not know the precise dictionary meaning of a word but have a general sense of how the word might be used, try to make up a phrase or sentence with the word. Substituting the answer choices in the phrase or sentence and seeing which best "fits," in that it reverses the meaning or tone of the sentence or phrase, may help you determine the correct answer.

Have you heard the word used before? How?

- Remember that a particular word may have more than one meaning, so if you are unable to find an answer choice that appears opposite to the given word, examine all the words for possible second meanings.

Multiple meanings again.

- Use your knowledge of root, prefix, and suffix meanings to help you determine the meanings of words with which you are not entirely familiar.

Directions: **Each question below consists of a word printed in capital letters followed by five lettered words or phrases. Choose the lettered word or phrase that is most nearly *opposite* in meaning to the word in capital letters. Since some of the questions require you to distinguish fine shades of meaning, be sure to consider all the choices before deciding which one is best.**

5. DIFFUSE: (A) concentrate (B) contend (C) imply (D) pretend (E) rebel

This is an easy question; the answer is (A). *Diffuse* means to permit or cause to spread out; only (A) presents an idea that is in any way opposite to *diffuse*.

6. COINCIDENCE: (A) depletion (B) incongruity (C) pessimism (D) ill fortune (E) lack of ideas

This is a question of middle difficulty. One meaning of *coincidence* is being in harmony or accord; another is corresponding in nature, character, or function. *Incongruity*, the correct answer, means lack of harmony or lack of conformity. Answer choice (D) may seem plausible at first glance since a *coincidence* of events is often a pleasant chance occurrence ("good luck" as opposed to "bad luck"), but careful reflection reveals that a *coincidence* is not necessarily a positive phenomenon.

7. MULTIFARIOUS: (A) deprived of freedom (B) deprived of comfort (C) lacking space (D) lacking stability (E) lacking diversity

Multifarious means having or occurring in great variety, so the correct answer is (E). Even if one is not entirely familiar with the meaning of *multifarious*, it is possible to use the clue provided by "multi-" to help find the right answer to this question of moderate difficulty.

8. PARSIMONIOUS: (A) initial (B) vegetative (C) prodigal (D) affluent (E) impromptu

The answer to this difficult question is (C); *parsimonious* means frugal to the point of stinginess, and *prodigal*, which means extravagant to the point of wastefulness, is the only answer choice opposite in meaning. At first, answer choice (D), *affluent*, may seem plausible in that it may be thought that wealth is an opposite concept to frugality—but it is well known that not all wealthy persons are generous.

SENTENCE COMPLETIONS

The purpose of the sentence completion questions is to measure the ability to recognize words or phrases that both logically and stylistically complete the meaning of a sentence. In deciding which of five words or sets of words can best be substituted for blank spaces in a sentence, one must analyze the relationships among the component parts of the incomplete sentence. One must consider each answer choice and decide which completes the sentence in such a way that the sentence has a logically satisfying meaning and can be read as a stylistically integrated whole.

Sentence completion questions provide a context within which to analyze the function of words as they relate to and combine with one another to form a meaningful unit of discourse.

Some approaches that may be helpful in answering sentence completion questions:

- Read the entire sentence carefully before you consider the answer choices; be sure you understand the ideas expressed in the sentence and examine the sentence for possible indications of tone (irony, humor, and the like).

  sadness, optimism,...

- Before reading the answer choices you may find it helpful to fill in the blanks with a word or words of your own that complete the meaning of the sentence. Then examine the answer choices to see if any of them parallels your own completion of the sentence.

  First, see how your own words fit.

- Pay attention to grammatical clues in the sentence. For example, words like *although* and *nevertheless* indicate that some qualification or opposition is taking place in the sentence; whereas *moreover* implies an intensification or support of some idea in the sentence. Pay attention also to the style of, and choice of words in, the sentence; sometimes determining the best answer depends in whole or in part on considerations of stylistic consistency among the parts of the sentence.

  some words act as signals.

- If a sentence has two blanks, be sure that *both* parts of your answer choice fit logically and stylistically into the sentence. Do not choose an answer on the basis of the "fit" of the first word alone.

- When you have chosen an answer, read the complete sentence through to check that it has acquired a logically and stylistically satisfying meaning.

  See how your answer sounds.

Directions: **Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five lettered words or sets of words. Choose the word or set of words for each blank that *best* fits the meaning of the sentence as a whole.**

9. Early ——— of hearing loss is ——— by the fact that the other senses are able to compensate for moderate amounts of loss, so that people frequently do not know that their hearing is imperfect.

(A) discovery . . indicated (B) development . . prevented (C) detection . . complicated (D) treatment . . facilitated (E) incidence . . corrected

The statement that the other senses compensate for partial loss of hearing indicates that the hearing loss is not *prevented* or *corrected*; therefore, choices (B) and (E) can be eliminated. Furthermore, the ability to compensate for hearing loss certainly does not facilitate the early *treatment* (D) or the early *discovery* (A) of hearing loss. It is reasonable, however, that early *detection* of hearing loss is *complicated* by the ability to compensate for it. The correct answer is (C).

10. The ——— science of seismology has grown just enough so that the first overly bold theories have been ———.

(A) magnetic . . accepted (B) fledgling . . refuted (C) revolutionary . . analyzed (D) predictive . . protected (E) exploratory . . recalled

At first reading, there may appear to be several answer choices that "make sense" when substituted in the blanks of the sentence. (A) and (D) can be dismissed fairly readily when it is seen that *accepted* and *protected* are not compatible with *overly bold* in the sentence. The sentence yielded by (C) is logically more acceptable but not as strong as the sentences yielded by (B) and (E). Of these two latter choices, (B) is superior on stylistic grounds: theories are not *recalled* (E), and *fledgling* (B) reflects the idea of growth present in the sentence. This is a question of middle difficulty.

11. If her characters are still being written about as unfathomable riddles, it is to be attributed more to a human passion for ——— than to dubious complexities of her art.

(A) conundrums (B) platitudes (C) scapegoats (D) euphemisms (E) stereotypes

The answer to this difficult question is (A). While any of the answer choices may be argued to be an object of human passion, only *conundrums* enables the sentence *as a whole* to acquire a coherent meaning. It is necessary, in choosing an answer, to complete the sentence in such a way as to make clear why the writer's characters are seen as *unfathomable riddles*. A human penchant for *conundrums*, or puzzling questions whose answers can only be conjectural, will account for this.

READING COMPREHENSION

The purpose of the reading comprehension questions is to measure the ability to read with understanding, insight, and discrimination. This type of question explores the examinee's ability to analyze a written passage from several perspectives, including the ability to recognize both explicitly stated elements in the passage and assumptions underlying statements or arguments in the passage as well as the implications of those statements or arguments. Because the written passage upon which reading comprehension questions are based presents a sustained discussion of a particular topic, there is ample context for analyzing a variety of relationships; for example, the function of a word in relation to a larger segment of the passage, the relationships among the various ideas in the passage, or the relation of the author to his or her topic or to the audience.

There are six types of reading comprehension questions. These types focus on (1) the main idea or primary purpose of the passage; (2) information explicitly stated in the passage; (3) information or ideas implied or suggested by the author; (4) possible application of the author's ideas to other situations; (5) the author's logic, reasoning, or persuasive techniques; and (6) the tone of the passage or the author's attitude as it is revealed in the language used.

You'll surely see some of each, so read accordingly

In each edition of the Aptitude Test, there are two relatively long reading comprehension passages, each providing the basis for answering seven or eight questions, and two relatively short passages, each providing the basis for answering three or four questions. The four passages are drawn from four different subject matter areas: the humanities, the social sciences, the biological sciences, and the physical sciences.

Don't be "put off" if it's not from your area.

Some approaches that may be helpful in answering reading comprehension questions:

- Since reading passages are drawn from many different disciplines and sources, you should not expect to be familiar with the material in all the passages. However, you should not be discouraged by encountering material with which you are not familiar; questions are to be answered on the basis of the information provided in the passage, and you are not expected to rely on outside knowledge, which you may or may not have, of a particular topic. You may, however, want to do last a passage that seems to you particularly difficult or unfamiliar.

Strategy, again!

- There are different strategies for approaching reading comprehension questions; you must decide which works most effectively for you. You might try different strategies as you do the reading comprehension questions in the sample test in this booklet. Some different strategies are: reading the passage very closely and then proceeding to the questions; skimming the passage, reading quickly through the questions, and then rereading the passage closely; and reading the questions first, then reading the passage closely. You may find that different strategies work better for different kinds of passages; for example, it might be helpful with a difficult or unfamiliar passage to read through the questions first.

.... and again!
Experiment with them.

- Whatever strategy you choose, you should analyze the passage carefully before answering the questions. As with any kind of close and thoughtful reading, you should be sensitive to clues that will help you understand less explicit aspects of the passage. Try to separate main ideas from supporting ideas or evidence; try also to separate the author's own ideas or attitudes from information he or she is simply presenting. It is important to note transitions from one idea to the next and to examine the relationships among the different ideas or parts of the passage: Are they contrasting? Are they complementary?, for example. You should consider both the points the author makes and the conclusions he or she draws and also how and why those points are made or conclusions drawn.

Not all ideas are equally important.
How do ideas relate to each other?

- You may find it helpful to underline or mark key parts of the passage. For example, you might underline main ideas or important arguments or you might circle transitional words that will help you map the logical structure of the passage (*although, nevertheless, correspondingly,* and the like) or descriptive words that will help you identify the author's attitude toward a particular idea or person.

Underlining -- a useful technique!
Look for keywords.

- Read each question carefully and be certain that you understand exactly what is being asked.

- *Always* read all the answer choices before selecting the best answer.

- The best answer is the one that most accurately and most completely answers the question being posed. Be careful not to pick an answer choice simply because it is a true statement; be careful also not to be misled by answer choices that are only partially true or only partially satisfy the problem posed in the question.

Several answers may be pretty good.

- Answer the questions on the basis of the information provided in the passage and do not rely on outside knowledge. Your own views or opinions may sometimes conflict with the views expressed or the information provided in the passage; be sure that you work within the context provided by the passage. You should not expect to agree with everything you encounter in reading passages.

Use only what is given in the passage.
Don't let disagreements with the author's view affect your choices.

Directions: The passage is followed by questions based on its content. After reading the passage, choose the best answer to each question. Answer all questions following the passage on the basis of what is *stated* or *implied* in the passage.

In the years following the Civil War, economic exploitation for the first time was provided with adequate resources and a competent technique, and busy prospectors were daily uncovering new sources of wealth. The coal and oil of Pennsylvania and Ohio, the copper and iron ore of Upper Michigan, the gold and silver, and the lumber and fisheries of the Pacific Coast provided limitless raw materials for the rising industrialism. The Bessemer process quickly turned an age of iron into an age of steel and created the great mills of Pittsburgh from which issued the rails for expanding railways. The reaper and binder, the sulky plow, and the threshing machine created a large scale agriculture on the fertile prairies. Wild grasslands provided grazing for immense herds of cattle and sheep; the development of the corn belt enormously increased the supply of hogs; and with railways at hand the Middle Border poured into Omaha and Kansas City and Chicago an endless stream of produce.

As the line of the frontier pushed westward, new towns were built, thousands of claims to homesteads were filed, and speculator and promoter hovered over the prairies like buzzards seeking their carrion. With rising land values money was to be made out of unearned increment, and the creation of booms was a profitable industry. The times were stirring, and it was a shiftless fellow who did not make his pile. If he had been too late to file on desirable acres, he had only to find a careless homesteader who had failed in some legal technicality and "jump his claim." Good bottom land could be had even by late-comers if they were sharp at the game.

This bustling America of 1870 accounted itself a democratic world. A free people had put away all aristocratic privileges and, conscious of power, had gone forth to possess the last frontier. But America's essential social philosophy, which it found adequate to its needs, was summed up in three words—preemption, exploitation, progress. Its immediate and pressing business was to dispossess the government of its rich holdings. Lands in the possession of the government were so much idle waste, untaxed and profitless; in private hands they would be developed. They would provide work, pay taxes, support schools, enrich the community. Preemption meant exploitation and exploitation meant progress.

It was a simple philosophy and it suited the simple individualism of the times. The Gilded Age knew nothing of enlightenment; it recognized only the acquisitive instinct. That much at least the frontier had taught the great American democracy; and in applying to the resources of a continent the lesson it had been so well taught, the Gilded Age wrote a profoundly characteristic chapter of American history.

12. According to the passage, increased corn production was mainly responsible for an increase in the

(A) number of sheep (B) output of farm implements (C) supply of hogs (D) amount of pasture land (E) number of cattle

This is a relatively easy question based on the first paragraph of the passage. The author states explicitly that the development of the corn belt enormously increased the supply of hogs; therefore, the correct answer is (C).

13. As used by the author, the term "Gilded Age" refers to an age of

(A) social progress (B) intellectual enlightenment (C) frontier living (D) great fortunes (E) aristocratic privilege

The answer to this question of medium difficulty is (D). Choices (B) and (E) are specifically rejected in the passage by the statements that "the Gilded Age knew nothing of enlightenment" and that "a free people had put away all aristocratic privileges." The author states that the Gilded Age derived its "acquisitive instinct" from the frontier, but he does not suggest that a rough frontier life was the primary characteristic of the Gilded Age. (C) is not therefore the correct choice. Since there is nothing in the passage to indicate that social concerns such as public welfare and public health were of great importance, choice (A) can be eliminated. The focus of the passage is on material progress and the acquisition of material wealth, and these concepts are best represented by choice (D).

14. With which of the following aphorisms would the exploiters of the 1870s probably have been in strongest agreement?

(A) A penny saved is a penny earned.
(B) Nothing ventured, nothing gained.
(C) Grasp all, lose all.
(D) He who dances must pay the fiddler.
(E) The love of money is the root of all evil.

Answering this difficult question requires an accurate understanding of the exploiters' attitudes as such attitudes are implied throughout the passage. The exploiters would not agree with choice (E) because, as discussed in the passage, most were concerned with accumulating wealth and making profits. Further, the general absence of moral concepts in the ideas of "making a pile" or "jumping a claim" suggest little agreement with (E) or with choice (D), which clearly suggests moral retribution. Further, there is in the passage no suggestion that the exploiters were concerned with consequences or with the possibility of loss, and for this reason both (C) and (D) are inappropriate. Finally, it is unlikely that the exploiters would agree with choice (A) because, as noted especially in the third paragraph, theirs was a philosophy of use and development rather than of simple frugality. In fact, the idea of use and development, of "preemption, exploitation, progress," is the chief clue to the correct answer (B), for the exploiters, driven by "the acquisitive instinct," knew that, without action, no profit was to be made.

GRE
GRADUATE RECORD EXAMINATIONS

TEST-TAKING STRATEGIES FOR THE QUANTITATIVE SECTION OF THE GRE APTITUDE TEST

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QUANTITATIVE COMPARISON

The quantitative comparison questions test the ability to reason quickly and accurately about the relative sizes of two quantities or to perceive that not enough information is provided to make such a decision. To solve a quantitative comparison problem, you compare the quantities given in two columns, Column A and Column B, and decide whether one quantity is greater than the other, whether the two quantities are equal, or whether the relationship cannot be determined from the information given. Some questions only require some manipulation to determine which of the quantities is greater; other questions require you to reason more or to think of special cases in which the relative sizes of the quantities reverse.

The following strategies might help in answering quantitative comparison questions.

- Do not waste time performing needless computations in order to eventually compare two specific numbers. Simplify or transform one or both of the given quantities only as much as is necessary to determine which quantity is greater or whether the two quantities are equal. Once you have determined that one quantity is greater than the other, do not take time to find the exact sizes of the quantities. Answer and go on to the next question.

If you find yourself doing long computations, you may be off the track.

- If both quantities being compared involve no variables, then the correct answer can never be (D), which states that the relationship cannot be determined. The answer is then reduced to three choices.

That is, if only numbers but no x's, y's, z's... are in the question.

- Consider all kinds of numbers before you make a decision. As soon as you establish that quantity A is greater in one case while quantity B is greater in another case, choose answer (D) immediately and move on to the next comparison.

If the answer depends on the particular numbers you plug in, you probably can't determine which quantity (A or B) is greater.

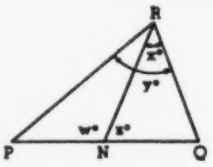
- Geometric figures are not usually drawn to scale. Comparisons should be made based on knowledge of mathematics rather than appearance. However, you can sometimes find a clue by sketching another figure in your test book. Try to visualize the parts of a figure that are fixed by the information given and the parts that are collapsible and changeable. If a figure can flow into other shapes and sizes while conforming to given information, the answer is probably (D).

Directions for quantitative comparison questions and some examples with explanations follow.

Directions: **Each of the following questions consists of two quantities, one in Column A and one in Column B. You are to compare the two quantities and choose**

A if the quantity in Column A is greater;
B if the quantity in Column B is greater;
C if the two quantities are equal;
D if the relationship cannot be determined from the information given.

Note:	**Since there are only four choices, NEVER MARK (E).**
Common Information:	**In a question, information concerning one or both of the quantities to be compared is centered above the two columns. A symbol that appears in both columns represents the same thing in Column A as it does in Column B.**
Numbers:	**All numbers used are real numbers.**
Figures:	**Position of points, angles, regions, etc. can be assumed to be in the order shown.**
	Lines shown as straight can be assumed to be straight.
	Figures are assumed to lie in the plane unless otherwise indicated.
	Figures that accompany questions are intended to provide information useful in answering the questions. However, unless a note states that a figure is drawn to scale, you should solve these problems NOT by estimating sizes by sight or by measurement, but by using your knowledge of mathematics (see Example 2 below).

	Column A	Column B	Sample Answers
Example 1:	**2 × 6**	**2 + 6**	**(A) ● (C) (D)**
Examples 2-4 refer to △PQR.			
Example 2:	**PN**	**NQ**	**(A) (B) (C) ●** **(since equal measures cannot be assumed, even though PN and NQ appear equal)**

	Column A	Column B	Sample Answers
Example 3:	**x**	**y**	**(A) ● (C) (D)** **(since N is between P and Q)**
Example 4:	**w + z**	**180**	**(A) (B) ● (E)** **(since PQ is a straight line)**

	Column A	Column B
15.	9.8	$\sqrt{100}$

$\sqrt{100}$ denotes 10, the positive square root of 100. (For any positive number x, $\sqrt{x}$ denotes the *positive* number whose square is x.) Since 10 is greater than 9.8, the correct answer is B. It is important not to confuse this question with a comparison of 9.8 and x where $x^2 = 100$. The latter comparison would yield D as the correct answer because $x^2 = 100$ implies that either $x = \sqrt{100}$ or $x = -\sqrt{100}$, and there is no way to determine which value x actually would have. However, this question asks for a comparison of 9.8 and $\sqrt{100}$, and $9.8 < \sqrt{100}$ for the reasons previously given.

16.	$(-6)^4$	$(-6)^3$

Since $(-6)^4$ is the product of four negative factors and the product of an even number of negative numbers is positive, $(-6)^4$ is positive. Since the product of an odd number of negative numbers is negative, $(-6)^3$ is negative. Therefore $(-6)^4$ is greater than $(-6)^3$ since any positive number is greater than any negative number. The correct answer is A. Do not waste time determining that $(-6)^4 = 1{,}296$ and that $(-6)^3 = -7{,}776$. This information is not needed to make the comparison.

17.	$x + y = 10$ $x - y = 2$	
	$x^2 - y^2$	19

Since $x^2 - y^2 = (x + y)(x - y)$ and, from the information given, $(x + y)(x - y) = 10 \cdot 2 = 20$, which is greater than 19, the correct answer is A. The two equations could be solved for x and y, giving $x = 6$ and $y = 4$, and then $x^2 - y^2$ could be computed, but this solution is more time-consuming.

	Column A	Column B
18.	The area of an equilateral triangle with side 6	The area of a right triangle with legs $\sqrt{3}$ and 9

The area of a triangle is one half the product of the lengths of the base and the altitude. In column A, the length of the altitude must first be determined. A sketch of the triangle may be helpful.

The altitude h divides the base of an equilateral triangle into two equal parts. From the Pythagorean theorem, $h^2 + 3^2 = 6^2$ or $h = 3\sqrt{3}$. Therefore the area of the triangle in column A is $\frac{1}{2} \cdot 6 \cdot 3\sqrt{3} = 9\sqrt{3}$. In column B, the base and the altitude of the right triangle are the two legs, and therefore the area is $\frac{9\sqrt{3}}{2}$. Since $9\sqrt{3}$ is greater than $\frac{9\sqrt{3}}{2}$, the correct answer is A.

Column A **Column B**

A point (x,y) is in region III.

19. **x** **y**

From the fact that point (x,y) is in region III, it is clear that x and y are both negative. However, since the location of the point within the region is not known, the relative sizes of x and y cannot be determined; for example, if the point is $(-3, -6)$, $x > y$ but if the point is $(-6, -3)$, $x < y$. Thus the answer is D.

$$(273 \times 87) + q = 29{,}235$$
$$(273 \times 87) + p = 30{,}063$$

20. **p** **q**

It is not necessary to do a lot of computation to solve this problem. The sum of a number and q is less than the sum of the same number and p. Therefore $q < p$, and the answer is A.

$$x^3 = y^3 + 1$$

21. **x** **y**

From the given equation, it can be determined that $x^3 > y^3$; however, the relative sizes of x and y cannot be determined. For example, if $y = 0$, x could be 1 or -1 and, since there is no way to tell which number x is, the answer is D.

DISCRETE QUANTITATIVE

Each discrete question contains all the information needed for answering the question except for the basic mathematical knowledge assumed to be common to the backgrounds of all examinees. Many of these questions require little more than manipulation and very basic knowledge; others require the examinee to read, understand, and solve a problem that involves either an actual or an abstract situation.

The following strategies might be helpful in answering discrete quantitative questions.

- Read each question carefully to determine what information is given and what is being asked.
- Before attempting to answer a question, scan the answer choices; otherwise you may waste time putting answers in a form that is not given (for example, putting an answer in the form $\frac{\sqrt{2}}{2}$ when the options are given in the form $\frac{1}{\sqrt{2}}$ or finding the answer in decimal form, such as 0.25, when the choices are given in fractional form, such as $\frac{1}{4}$).
- For questions that require approximations, scan the answer choices to get some idea of the required closeness of approximation; otherwise, you may waste time on long computations when a short mental process would be sufficient (for example, finding 48 percent of a number when taking half of the number would give a close enough approximation).

Know what kind of answer is expected.

Don't try to get an exact answer if an approximate one is all that is needed.

Directions for discrete quantitative questions and some examples with explanations follow.

Directions: **For each of the following questions, select the best of the answer choices given.**

Numbers: **All numbers used are real numbers.**

Figures: **Figures that accompany these questions are intended to provide information useful in answering the questions. They are drawn as accurately as possible EXCEPT when it is stated in a specific question that its figure is not drawn to scale. All figures lie in a plane unless otherwise indicated.**

22. The average of x and y is 20. If z = 5, what is the average of x, y, and z?

(A) $8\frac{1}{3}$ (B) 10 (C) $12\frac{1}{2}$ (D) 15 (E) $17\frac{1}{2}$

Since the average of x and y is 20, $\frac{x+y}{2} = 20$ or $x + y = 40$. Thus $x + y + z = x + y + 5 = 40 + 5 = 45$ and therefore $\frac{x+y+z}{3} = \frac{45}{3} = 15$. The correct answer is D.

23. Several years ago, Minnesota produced $\frac{2}{3}$ and Michigan $\frac{1}{6}$ of all the iron ore produced in the United States. If all the other states combined produced 18 million tons in a year, how many million tons did Minnesota produce that year?

(A) 27 (B) 36 (C) 54 (D) 72 (E) 162

Since Minnesota produced $\frac{2}{3}$ and Michigan $\frac{1}{6}$ of all the iron ore produced in the United States, the two states together produced $\frac{5}{6}$ of the iron ore. Therefore the 18 million tons produced by the rest of the United States was $\frac{1}{6}$ of the total production. Thus the total United States production was $6 \cdot 18 = 108$ million tons, and Minnesota produced $\frac{2}{3}(108) = 72$ million tons. The correct answer is D.

24. Into how many segments, each 20 centimeters long, can a segment 5 meters long be divided? (1 meter = 100 centimeters)

(A) 20 (B) 25 (C) 45 (D) 50 (E) 80

Using the given information that there are 100 centimeters in a meter, it can be determined that there are 500 centimeters in 5 meters. The number of segments, each 20 centimeters long, into which a 500-centimeter segment can be divided is $\frac{500}{20} = 25$. The answer is B.

25. If $\frac{x}{3} - \frac{x}{6} + \frac{x}{9} - \frac{x}{12} = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4}$, then x =

(A) 3 (B) 1 (C) $\frac{1}{3}$ (D) $-\frac{1}{3}$ (E) −3

This problem can be solved without a lot of computation by factoring $\frac{x}{3}$ out of the expression on the left side of the equation $\frac{x}{3} - \frac{x}{6} + \frac{x}{9} - \frac{x}{12} = \frac{x}{3}(1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4})$ and substituting the factored expression into the equation, obtaining $\frac{x}{3}(1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4}) = 1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4}$. Dividing both sides of the equation by $1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4}$ (which is not zero) gives the resulting equation, $\frac{x}{3} = 1$. Thus x = 3 and the answer is A.

26. In the figure above, if AE = ED = DC and the area of the shaded region is 5, what is the area of △ABC?

(A) 10 (B) 12.5 (C) 15 (D) 20 (E) 25

In this geometry problem, the shaded triangular region has a base that is $\frac{1}{3}$ the base of △ABC and has the same height as △ABC. Therefore, the area of the shaded region is $\frac{1}{3}$ the area of △ABC, and hence the area of △ABC = 3(5) = 15. The answer is C.

27. Joan earned twice as much as Bill and Sam earned $3 more than half as much as Bill. If the amounts earned by Joan, Bill, and Sam are j, b, and s, respectively, which of the following is a correct ordering of these amounts?

(A) j < b < s (B) j < s < b
(C) b < j < s (D) b < s < j
(E) It cannot be determined from the information given.

From the first sentence the following two equations can be written: j = 2b and $s = \frac{1}{2}b + 3$. The first equation implies that j is greater than b (j > b). The second equation, however, does not imply anything about the relationship between s and b; for example, if b = 2, $s = \frac{1}{2}(2) + 3 = 4$ and s > b but if b = 8, $s = \frac{1}{2}(8) + 3 = 7$ and s < b. Thus E is the best of the choices given.

DATA INTERPRETATION

The data interpretation questions, like the reading comprehension questions in the verbal measure, usually appear in sets. These questions are based on data presented in tables or graphs and test one's ability to synthesize information, to select appropriate data for answering a question, or to determine that sufficient information for answering a question is not provided.

The following strategies might help in answering sets of data interpretation questions.

- Scan the set of data briefly to see what it is about, but do not attempt to grasp everything before reading the first question. Become familiar with it gradually, while trying to answer the questions. Be sure to read all notes related to the data.

Don't waste time learning details that may not be needed.

- If a graph has insufficient grid lines, use the edge of the answer sheet as a grid line to help read more accurately.

- When possible, try to determine averages by visualizing a line through the important values and estimating the midpoint rather than reading off each value and then computing the average. Remember the average must be somewhere between the least value and the greatest value.

Sometimes estimates may be sufficient.

- If a question is too long and involved to take in at one time, break it down into parts and substitute the values from the graph for each part. Then reread the question and attempt to answer it.

- If the numbers are large, estimate products and quotients instead of performing involved computations.

Again, approximations may be sufficient.

- Remember that these questions are to be answered only on the basis of the data given, everyday facts (such as the number of days in a year), and your knowledge of mathematics. Do not make use of specific information that you recall that may seem to relate to the particular situation on which the questions are based unless that information is derivable from the data provided.

Don't read more information into the graph than is given.

The directions for data interpretation questions are the same as those for the discrete questions. Some examples of data interpretation questions with explanations follow.

***Questions 28-30* refer to the following table:**

PERCENT CHANGE IN DOLLAR AMOUNT OF SALES IN CERTAIN RETAIL STORES FROM 1977 TO 1979

Store	Percent Change From 1977 to 1978	Percent Change From 1978 to 1979
P	+10	−10
Q	−20	+9
R	+5	+12
S	−7	−15
T	+17	−8

28. In 1979 which of the stores had greater sales than any of the others shown?

(A) P (B) Q (C) R (D) S
(E) It cannot be determined from the information given.

Since the only information given in the table is the percent change from year to year, there is no way to compare the amount of sales for the stores in any one year. The best answer is E.

29. In store T, the sales for 1978 amounted to approximately what percent of the sales for 1979?

(A) 86% (B) 92% (C) 109% (D) 117% (E) 122%

If A is the amount of sales for store T in 1978, then 0.08 A is the amount of decrease and A − 0.08 A = 0.92 A is the amount of sales for 1979. Therefore the desired result can be obtained by dividing A by 0.92 A, which equals $\frac{1}{0.92}$ or approximately 109%. The best answer is C.

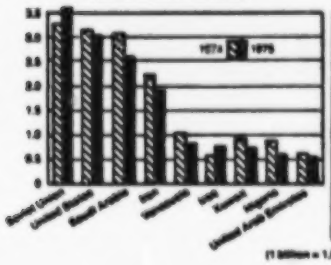
30. If sales in store P amounted to $800,000 in 1977, what did the sales amount to in that store in 1979?

(A) $727,200 (B) $792,000 (C) $800,000
(D) $880,000 (E) $968,000

If sales in store P amounted to $800,000 in 1977, then in 1978 they amounted to 110 percent of that; i.e., $880,000. In 1979 sales amounted to 90 percent of $880,000; i.e., $792,000. Note that an increase of 10 percent in one year and a decrease of 10 percent in the following year does not result in the same amount as the original amount of sales because the base used in computing the percents changes from $800,000 to $880,000. The correct answer is B.

***Questions 31-34* refer to the following data.**

World Crude Oil Production
(billions of barrels)



Revenues from Oil Exports
(billions of dollars)

	1973	1974	1975
Saudi Arabia	8.3	27.5	30.0
Iran	4.1	18.6	19.2
Iraq	1.8	8.0	8.3
Venezuela	3.3	10.3	8.2
Kuwait	2.0	8.3	7.8
United Arab Emirates	0.9	4.1	6.4
Nigeria	2.0	8.1	6.4
Libya	2.3	6.8	5.8
Indonesia	0.8	3.9	4.3
Algeria	1.3	4.1	3.4
Total	23.5	97.7	99.8

(1 billion = 1,000,000,000)

31. How many of the countries shown produced more crude oil in 1975 than in 1974?

(A) None (B) One (C) Two
(D) Three (E) Four

To answer this question, one needs only to examine the bar graph that deals with production and count the number of countries for which the solid bar is taller than the lined bar. The Soviet Union and Iraq are the only such countries; therefore, the answer is C.

32. In 1974, for which of the following countries were revenues from oil exports most nearly equal to 20 percent of the total for all the countries listed?

(A) Iran (B) Iraq (C) Kuwait
(D) Saudi Arabia (E) Venezuela

For this question, only the table is needed. Since 20 percent of the total (97.7) is a little less than 20, and 18.6, the revenue for Iran, is the only 1974 entry a little less than 20, the answer is A.

33. The country that had the greatest percent decrease in crude oil production from 1974 to 1975 had how many billions of dollars of revenue from oil exports in 1974?

(A) $27.5 (B) $18.6 (C) $10.3 (D) $8.1 (E) $4.1

This question requires the use of both the bar graph and the table. From the bar graph, it can be seen that there are eight countries that had a decrease in production; however, it would be very time-consuming to compute all of the percents. If the percent decrease is to be the greatest, then the difference between the two bars must be larger in relation to the height of the lined bar than any of the others. Some countries, such as the United States and United Arab Emirates, can be ruled out because the heights of the bars are so nearly the same. Venezuela and Kuwait can be ruled out because they have smaller differences but taller lined bars than Nigeria. Iran can be ruled out because it has about the same difference as Nigeria but a much taller lined bar. That leaves only Saudi Arabia and Nigeria and one would suspect that the ratio of the difference to the height of the lined bar is smaller for Saudi Arabia. A quick check shows that $\frac{0.5}{3}$ is less than $\frac{0.2}{0.9}$ and, therefore, Nigeria had the greatest percent decrease. From the table, Nigeria had 8.1 billions of dollars of revenue, and the best answer is D.

34. Which of the following can be concluded from the data?

I. In 1974, Iraq exported four times as many barrels of oil as in 1973.

II. In 1974, Iran exported three times as much oil as Iraq.

III. In 1975, the combined crude oil production of the Soviet Union, the United States, and Saudi Arabia was more than half of the total production of all nine countries shown.

(A) I only (B) II only (C) III only
(D) I and II (E) II and III

In this question, you have to decide whether each of three statements can be concluded from the data. Statement I cannot be concluded since no information is given about numbers of barrels exported in either year or about revenue per barrel in any given year. Although Iran's revenue in 1974 was approximately three times that of Iraq, no information is given about the cost per barrel in each of the countries; therefore, Statement II cannot be concluded. Note that it cannot be assumed that the price per barrel is the same in Iran and Iraq (although it might seem to be a reasonable assumption on the basis of outside knowledge) because no such information is provided in the data. In 1975 the combined production of the Soviet Union, the United States, and Saudi Arabia was about 9 billion barrels. Iran's production was about 2 billion and the remaining 5 countries produced less than 1 billion each, giving a total of less than 7 billion barrels for these countries. Therefore Statement III can be concluded, and the answer is C.

GRE
GRADUATE RECORD EXAMINATIONS

TEST-TAKING STRATEGIES FOR THE ANALYTICAL SECTION OF THE GRE APTITUDE TEST

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ANALYTICAL REASONING

Analytical reasoning questions test the ability to understand a given structure of arbitrary relationships among fictitious persons, places, things, or events; to deduce new information from the relationships given; and to assess the conditions used to establish the structure of relationships. Each analytical reasoning group consists of (1) a set of about three to seven related statements or conditions (and sometimes other explanatory material) describing a structure of relationships, and (2) three or more questions that test understanding of that structure and its implications. Although each question in a group is based on the same set of conditions, the questions are independent of one another; answering one question in a group does not depend on answering any other question.

No knowledge of formal logic or mathematics is required for solving analytical reasoning problems. Although some of the same processes of reasoning are involved in solving both analytical reasoning problems and problems in those specialized fields, analytical reasoning problems can be solved using knowledge, skills, vocabulary, and computational ability (simple addition and subtraction) common to college students.

Common sense does help though!

Each group of analytical reasoning questions is based on a set of conditions that establish relationships among persons, places, things, or events. These relationships are common ones such as temporal order (X arrived before Y but after Z), spatial order (City X is west of point Y and point Z), set membership (If Professor Green serves on the committee, then Professor Brown must also serve), cause and effect (Event Q always causes event R), and family relationship (Mary is Juan's mother and Belinda's sister-in-law). The conditions should be read carefully to determine the exact nature of the relationship or relationships involved. Some relationships are fixed or constant (The second house on the block belongs to P). Other relationships are variable (Q must be assigned to either campsite 1 or campsite 3). Some relationships that are not given can be easily deduced from those given. (If one condition about books on a shelf specifies that book L is to the left of book Y, and another specifies that book P is to the left of book L, then it can be deduced that book P is to the left of book Y.)

Think about how you can represent these relationships -- tables, diagrams, lists...

The following strategies may be helpful in answering analytical reasoning questions:

- In general, it is best to answer first those questions in a group that seem to pose little difficulty and then to return to those that seem troublesome. It is best not to start one group before finishing another because much time can be lost later in returning to an analytical reasoning group and reestablishing familiarity with its relationships. Do not avoid a group merely because its conditions look long or complicated.

Mark the test booklet to show the ones you've skipped.

- In reading the conditions, it is important not to introduce unwarranted assumptions; for instance, in a set establishing relationships of height and weight among the members of a team, do not assume that a person who is taller than another person must weigh more than that person.

Don't assume more than is given.

- Since it is intended that the conditions be as clear as possible, avoid interpreting them as if they were designed to trick you by means of hidden ambiguities or other such devices. When in doubt, read the conditions in their most obvious, common-language sense. This does not mean, however, that the language in the conditions is not intended to be read for precise meaning. It is essential, for instance, to pay particular attention to function words that describe or limit relationships, such as *only, exactly, never, always, must be, cannot be,* and the like. The result of the thorough reading described above should be a clear picture of a structure of relationships, including what kind or kinds of relationships are involved, who or what the participants in the relationships are, and what is and is not known about the structure of the relationships. For instance, at this point it can often be determined whether only a single configuration of relationships is permitted by the conditions or whether alternatives are permitted.

Testers are not really as devious as you may suppose!

- Many examinees find it useful to underline key points in the conditions or to draw a simple diagram, as the directions for the analytical sections suggest.

Don't get too complicated.

- Even though some people who solve analytical reasoning problems find diagrams to be helpful, other people seldom resort to them. And among those who do regularly use diagrams, there is by no means universal agreement on which kind of diagram is best for which problem or in which cases a diagram is most useful. Therefore, do not be concerned if a particular problem in the test seems to be best approached without the use of diagrams.

Decide for yourself what kind of diagrams, if any, may help.

- Each question should be considered separately from the other questions in its group; no information, except what is given in the original conditions, should be carried over from one question to another. In many cases a question will simply ask for conclusions to be drawn from the conditions as originally given. An individual question can, however, add information to the original conditions or temporarily suspend one of the original conditions for the purpose of that question only.

Pay careful attention to what the questions say regarding this.

Questions 40-42

To apply to college a student must see the school counselor, obtain a transcript at the transcript office, and obtain a recommendation from Teacher A or Teacher B.
A student must see the counselor before obtaining a transcript.
The counselor is available only Friday mornings and Tuesday, Wednesday, and Thursday afternoons.
The transcript office is open only Tuesday and Wednesday mornings, Thursday afternoons, and Friday mornings.
Teacher A is available only Monday and Wednesday mornings.
Teacher B is available only Monday afternoons and Friday mornings.

40. A student has already seen the counselor and does not care from which teacher she obtains her recommendation. Which of the following is a complete and accurate list of those days when she could possibly complete the application process in one day?

(A) Friday (B) Monday, Wednesday
(C) Monday, Friday (D) Wednesday, Friday
(E) Monday, Wednesday, Friday

To complete the application process in one day, the student has to obtain a transcript and a recommendation on the same day. This will be possible on Wednesdays, when both the transcript office and teacher A are accessible, and on Fridays, when both the transcript office and teacher B are accessible, and at no other time. The only other day that a teacher recommendation can be obtained is Monday, but on Mondays no transcripts can be obtained. Thus, the correct answer is (D).

41. A student completed his application procedure in one day. Which of the following statements must be true?

I. He obtained his recommendation from Teacher A.
II. He obtained his recommendation from Teacher B.
III. He completed the procedure in the morning.

(A) I only (B) II only (C) III only
(D) I and III only (E) II and III only

If a student completed the entire application procedure in a single day, that day must have been a Friday. It could not have been a Monday, since on Mondays neither counselor nor transcript office is accessible. It could not have been either a Tuesday or a Thursday, because on neither of these days would a teacher have been available for a recommendation. And it could not have been a Wednesday because on Wednesdays one cannot see the counselor before obtaining a transcript. Now, given that the student in question must have done everything on a Friday, I must be false since teacher A is not available on Fridays, II must be true since teacher B is both available on Fridays and the only teacher to be so available, and III must also be true since on Fridays all of the relevant business can only be conducted in the morning. Therefore, the correct answer is (E).

42. A student has already obtained his transcript and does not care from which teacher he obtains his recommendation. Which of the following is a complete and accurate list of those days when he could possibly complete the application process?

(A) Friday (B) Monday, Wednesday
(C) Monday, Friday (D) Wednesday, Friday
(E) Monday, Wednesday, Friday

If the student has already obtained his transcript, he must have seen the counselor, too, since seeing the counselor must precede receipt of a transcript. This means that obtaining a recommendation from a teacher is all that is left to do. Since it does not matter which teacher the recommendation is from, the application process can be completed on any day that either teacher A or teacher B is available. Those days are Monday, when both are available, Wednesday, when A is available, and Friday, when B is available. The correct answer, therefore, is (E).

Questions 35-36

A half tone is the smallest possible interval betwer a notes.
Note T is a half tone higher than note V.
Note V is a whole tone higher than note W.
Note W is a half tone lower than note X.
Note X is a whole tone lower than note T.
Note Y is a whole tone lower than note W.

35. Which of the following represents the relative order of the notes from the lowest to the highest?

(A) X Y W V T (B) Y W X V T (C) W V T Y X
(D) Y W V T X (E) Y X W V T

The answer to this relatively easy question can be determined by reading the six given statements and understanding the relationships among them. The relationships may be clarified by drawing a simple illustrative diagram:

T
V
X
W

Y

The diagram shows the relative order of the notes; since the question asks for the order from the lowest note to the highest, the correct answer is (B).

36. Which of the following statements about an additional note, Z, could NOT be true?

(A) Z is higher than T. (B) Z is lower than Y.
(C) Z is lower than W. (D) Z is between W and Y.
(E) Z is between W and X.

Since W and X are a half tone apart, and since a half tone is the smallest possible interval between notes, Z cannot be between W and X. The correct answer is therefore (E). This question is also relatively easy.

Questions 37-39

F, H, I, J, K, L, M, and N spoke, but not necessarily in that order. Only one person spoke at a time.
F spoke after L and took more time than H.
I spoke before M and after H, and took less time than K.
J spoke after N and before H, and took less time than N and more time than K.
N spoke after F and took less time than H.

37. Of the following, which spoke first?

(A) H (B) I (C) J (D) L (E) N

38. Of the following, which took the most time?

(A) F (B) H (C) J (D) K (E) N

39. Which of the following must be true?

(A) F was the second speaker and gave the third lengthiest speech.
(B) H spoke before I and took more time than N.
(C) I spoke last and gave the shortest speech.
(D) J spoke after M and took less time than F.
(E) N spoke after L and took more time than F.

These questions may be answered by making two lists of the speakers, as follows:

Order of appearance: L F N J H I M
Length of speech: F H N J K I

From these two lists the answers to all three questions emerge. The answer to 37 is (D), to 38 (A), and to 39 (B). For question 39, it is necessary to note that although (A) could be true, there is insufficient information provided to establish that it must be true. These questions are of medium difficulty.

LOGICAL REASONING

Logical reasoning questions test the ability to understand, analyze, and evaluate arguments. Some of the abilities tested by specific questions include recognizing the point of an argument, recognizing assumptions on which an argument is based, drawing conclusions from given premises, inferring material missing from given passages, applying principles governing one argument to another, identifying methods of argument, evaluating arguments and counterarguments, and analyzing evidence.

Each question or group of questions is based on a short argument, generally an excerpt from the kind of material graduate students are likely to encounter in their academic and personal reading. Although arguments may be drawn from specific fields of study such as philosophy, literary criticism, social studies, and the physical sciences, materials from more familiar sources such as political speeches, advertisements, and informal discussions or dialogues also form the basis for some questions. No specialized knowledge of any particular field is required for answering the questions, however, and no knowledge of the terminology of formal logic is presupposed.

Specific questions asked about the arguments draw on information obtained by the process of critical and analytical reading described above.

The following strategies may be helpful in answering logical reasoning questions:

- The passage on which a question (or questions) is based should be read very carefully with close attention to such matters as (1) what is said specifically about a subject, (2) what is not said but necessarily follows from what is said, (3) what is suggested or claimed without substantiation in what is said. In addition, the means of relating statements, inferences, and claims—the structure of the argument—should be noted. Such careful reading may lead to the conclusion that the argument presented proceeds in an unsound or illogical fashion, but in many cases there will be no apparent weakness in the argument. It is important, in reading the arguments given, to attend to the soundness of the method employed and not to the actual truth of opinions presented.

Note what is said and what is left unsaid.

How the argument is made is more important than whether you agree with the opinions.

- It is important to determine exactly what information the question is asking for; for instance, although it might be expected that one would be asked to detect or name the most glaring fault in a weak argument, the question posed may actually ask for the selection of one of a group of other arguments that reveals the same fault. In some cases, questions may ask for a negative response, for instance, a weakness that is NOT found in an argument or a conclusion that CANNOT be drawn from an argument.

Make sure you know what the question asks for.

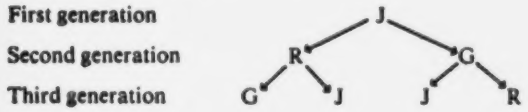
Questions 43-46

In a certain society there are three marriage groups—J, G, and R.
A man and a woman may marry if and only if they belong to the same group.
The sons of group-J parents belong to group R; the daughters belong to group G.
The sons of group-G parents belong to group J; the daughters belong to group R.
The sons of group-R parents belong to group G; the daughters belong to group J.

43. Which of the following is a complete and accurate list of the groups to which the grandchildren of a couple belonging to group J could possibly belong?

(A) J (B) G, J (C) G, R (D) J, R (E) G, J, R

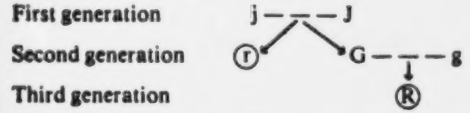
The following diagram based on the conditions given shows (E) to be the correct answer:



44. Under the rules given, may a man marry his niece?

(A) No.
(B) Yes, if she is his brother's daughter.
(C) Yes, if she is his sister's daughter.
(D) Yes, if she is his wife's brother's daughter.
(E) Yes, if she is his wife's sister's daughter.

The following diagram shows (C) to be the correct answer (capital letters designate females, lower-case letters designate males, dashes between two letters designate a married couple, and arrows go from parents to their offspring):



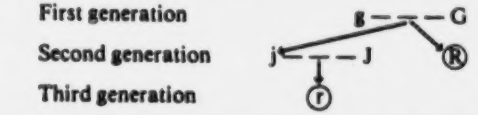
The man and the niece he could marry are both circled. Note that, to pick (C) as the correct answer, it is not necessary to show that what has just been demonstrated to be true of males belonging to group R is also true of males belonging to other groups, although this can, in fact, be shown. This is a difficult question.

45. Which of the following kinds of aunts may a man marry?

I. His mother's sister
II. His father's sister
III. The widow of his father's brother

(A) I only (B) II only (C) III only
(D) I and II only (E) I, II, and III

The following diagram shows that a man's father's sister is a kind of aunt he may marry (the diagramming technique is as explained under question 44):



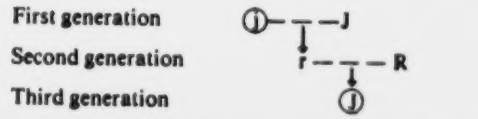
The man and the aunt he may marry are circled. Diagrams of the same general type will show that I and III are both false, so that (B) is the correct choice. This is a very difficult question.

46. Which of the following statements can be inferred from the rules given?

I. A brother and sister may not marry.
II. A woman may not marry her father.
III. A man may not marry his granddaughter.

(A) I only (B) II only (C) III only
(D) I and II only (E) I, II, and III

We can infer that a brother and sister may not marry by simply noting that brother and sister always belong to different groups. We can infer that a woman may not marry her father by noting that parent and child always belong to different groups. Therefore, both I and II can be inferred. III, however, cannot be inferred, for as the following diagram shows, a man may marry his granddaughter:



The man and the granddaughter who belong to the same group and may thus marry are circled. Therefore, (D) is the correct answer.

47. If Ramón was born in New York State, then he is a citizen of the United States.

The statement above can be deduced logically from which of the following statements?

(A) Everyone born in New York State is a citizen of the United States.
(B) Every citizen of the United States is a resident either of one of the states or of one of the territories.
(C) Some people born in New York State are citizens of the United States.
(D) Ramón was born either in New York or in Florida.
(E) Ramón is a citizen either of the United States or of the Dominican Republic.

The question here is which of (A) through (E), if true, would guarantee that Ramón cannot have his birthplace in New York State without being a United States citizen. Since, crucially, the relationship between birthplace and citizenship is at stake, any statement that concerns itself with birthplace alone, like (D), or citizenship alone, like (E), or with the relationship between residence and citizenship, like (B), will be unsuitable for providing any such guarantee. This leaves (A) and (C), both of which deal with the relationship at issue here. Of these, (C) makes the weaker claim: It leaves open the possibility that there might be people born in New York State who are not United States citizens, and it leaves open whether or not Ramón is one of those people. (A), on the other hand, rules out any possibility of anyone being born in New York State and yet not being a United States citizen. Therefore, (A) rules out that possibility for Ramón also, and (A) is thus the correct answer. This question is easy.

48. There is no reason to rule out the possibility of life on Uranus. We must, then, undertake the exploration of that planet.

The argument above assumes that

(A) life exists on Uranus
(B) Uranus is the only other planet in the solar system capable of supporting life
(C) Uranian life would be readily recognizable as life
(D) the search for life is a sufficient motive for space exploration
(E) no one has previously proposed the exploration of Uranus

The argument is based on the weak claim that there is a possibility that life may exist on Uranus and not on the stronger claim that life on Uranus actually exists; since logically weak claims do not presuppose logically stronger claims, (A) is not an assumption. (B) is likewise readily eliminated since the author's argument is presented as independent of any comparison of Uranus with other planets. (E) is also clearly not the correct answer: There is no hint in the argument that its author takes it to be a novel one or takes its conclusion to be a novel one. (C) comes closer to being an assumption of the argument: If the mere possibility of the existence of life on Uranus is taken as an impetus for exploration, we can safely conclude that a major aim of any such exploration would be to ascertain whether or not there actually was life on Uranus. But this search for life does not presuppose that the techniques scientists on earth have for detecting life will be adequate for recognizing possibly alien life forms in every case. Even less is it presupposed that this task will be relatively easy. So (C) cannot be an assumption of the argument. The correct answer is (D), for, if (D) is true, the mere possibility of there being life on Uranus is indeed a compelling reason for the exploration of the planet. This question, too, is an easy one.

49. Most people who stop smoking gain weight; therefore, if Mark does not stop smoking, he will probably not gain weight.

The argument above is most like which of the following?

(A) Most spiders live in dry places; therefore, spiders are probably found in all deserts.

(B) Most crimes of violence have increased in number during the past few years; therefore, law enforcement during this period has become lax.

(C) Most new sports cars are equipped with radial tires; therefore, Eve's new sports car may not be equipped with radial tires.

(D) Most countries ruled by dictators do not have a free press; therefore, the nation of Nogub, which is ruled by a dictator, probably does not have a free press.

(E) Most popular television programs are of low intellectual quality; therefore, "Fun Fair," an unpopular program, is probably of high intellectual quality.

The argument to be matched draws the inference that a particular individual not belonging to a certain group probably lacks a certain property that most of the members of that group possess. This is an invalid form of argumentation, but the argument shares this property with (A), (B), and (E); considerations of validity alone are thus not sufficient to select one of (A) through (E) as being most similar to the original argument. When we bring considerations of argument structure to bear, the situation changes. For (A) to have the same structure as the given argument, it would have to infer something about some particular animal that was not a spider on the basis of something being true of most spiders. Similarly (B) would have to be an inference about a particular incident that was not a crime of violence, (C) about some object that was not a new sports car, and (D) about a particular country that was not ruled by a dictator. It is readily apparent that (A), (B), (C), and (D) all lack a feature they would have to have to be closely parallel in structure to the original argument. Contrast this with (E). We know now that (E) would have to be about something that was not a popular television program, and further, that (E) would have to say that that thing was likely to have a property that is the opposite of a property most popular television programs have. Both of these conditions are satisfied; therefore (E) is the correct answer. This question is of about average difficulty.

50. Offshore blasting in oil exploration does not hurt fishing; blasting started this year, and this year's salmon catch has been the largest in a long time.

All of the following statements, if true, are valid objections to the argument above EXCEPT:

(A) The salmon is only one of many species of fish that might be affected by the blasts.

(B) The rapid changes of water pressure caused by the blasts make salmon mate more frequently.

(C) The noise of the blasts interferes with the food chain salmon depend on.

(D) Factors that have nothing to do with the well-being of salmon may significantly affect the size of one year's catch.

(E) Vibrations from the blasts destroy fish eggs.

The given argument draws a general conclusion on the basis of a seemingly relevant particular observation. The question takes for granted that the general conclusion drawn is not adequately supported by the evidence cited and asks for a discrimination between the kinds of factual observations that would actually show the argument to be flawed and the kinds of factual observations that would not do so. (A) points out that some other kinds of fish may be hurt even if salmon are not. (D) points out that the size of the catch depends on other factors, like the number of fishermen trying to catch fish. (C) and (E) both revolve around the fact that the argument seems to assume that any effects of offshore blasting would have immediate impact on fishing; both point out facts that are reasonably construed as implying negative effects of the blasts in the long run. (B), on the other hand, is most naturally construed as suggesting that the salmon population may well increase, which in turn should help fishing rather than hurt it. So (B) is most readily interpreted as making the conclusion of the argument more likely to be true. Since no statement that supports the conclusion of an argument will, under ordinary circumstances, constitute a valid objection to that argument, (B) is the correct answer. This question is moderately difficult.

Appendix B

Suggestions for Improving Speed

Suggestions for Improving Your Speed in Answering GRE Quantitative Test Questions

■ In preparing to take a test, you should become thoroughly familiar with the directions in the sample Aptitude Test. Even if you have done so, however, when you actually take the test, read the directions for each group of questions carefully. Work as rapidly as you can without being careless.

Memorize them!

■ After you have familiarized yourself with the sample questions, take the sample test under conditions that simulate those in an actual test administration, observing the time limits imposed and focusing your attention on the questions just as seriously as you expect to do when you take the test to earn scores.

Practice taking it against the clock!

■ You may find it advantageous to go through a section of the Aptitude Test a first time quite rapidly, answering only the questions you are confident of. Then go back and answer the questions that require somewhat more thought, and finally tackle the very difficult questions, if you have time, on a third pass. Remember that the Aptitude Test is designed so that even those examinees who earn the highest scores are unlikely to answer every question correctly. Questions of average difficulty are answered correctly by about half the examinees.

Mark the test booklet to show the questions you plan to return to!

Don't panic. It's a difficult test for others, too.

■ Do not waste time pondering individual questions you find extremely difficult or unfamiliar. No question carries greater weight than any other. You are advised to work as rapidly as you can without losing accuracy. Do not spend too much time on questions that are too difficult for you. Go on to the other questions and come back to the difficult ones later.

Answer the ones that are easiest for you. They count as much as the hard ones.

■ Bring a wristwatch to the test center.

There might not be a clock there!

■ There are several different types of questions; you will find special directions for each type in the test itself. Be sure you understand the directions before attempting to answer any questions. The directions for each Quantitative question type are included on the following page.

Again, memorize them!

Note. Same suggestions were provided for each test section.

Directions for Each Quantitative Question Type

Quantitative Comparisons

Directions: Each of the following questions consists of two quantities, one in Column A and one in Column B. You are to compare the two quantities and choose

A if the quantity in Column A is greater;
B if the quantity in Column B is greater;
C if the two quantities are equal;
D if the relationship cannot be determined from the information given.

Note: Since there are only four choices, NEVER MARK (E).

Common Information: In a question, information concerning one or both of the quantities to be compared is centered above the two columns. A symbol that appears in both columns represents the same thing in Column A as it does in Column B.

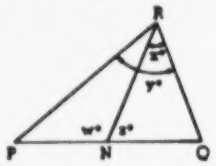
Numbers: All numbers used are real numbers.

Figures: Position of points, angles, regions, etc. can be assumed to be in the order shown.

Lines shown as straight can be assumed to be straight.

Figures are assumed to lie in the plane unless otherwise indicated.

Figures that accompany questions are intended to provide information useful in answering the questions. However, unless a note states that a figure is drawn to scale, you should solve these problems NOT by estimating sizes by sight or by measurement, but by using your knowledge of mathematics (see Example 2 below).

	Column A	*Column B*	*Sample Answers*
Example 1:	2 × 6	2 + 6	● Ⓑ Ⓒ Ⓓ
Examples 2-4 refer to △PQR.			
Example 2:	PN	NQ	Ⓐ Ⓑ Ⓒ ● (since equal measures cannot be assumed, even though PN and NQ appear equal)
Example 3:	x	y	Ⓐ ● Ⓒ Ⓓ (since N is between P and Q)
Example 4:	w + z	180	Ⓐ Ⓑ ● Ⓓ (since PQ is a straight line)
	$8x + 4 = 10$		
4.	$4x + 2$	$\frac{10}{4}$	

Discrete Quantitative

Directions: For each of the following questions, select the best of the answer choices given.

Numbers: All numbers used are real numbers.

Figures: Figures that accompany these questions are intended to provide information useful in answering the questions. They are drawn as accurately as possible EXCEPT when it is stated in a specific question that its figure is not drawn to scale. All figures lie in a plane unless otherwise indicated.

$1.25 \times 0.40 =$

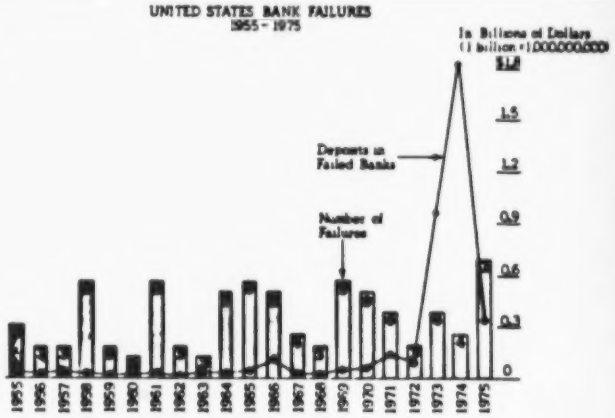
(A) $\frac{1}{2}$ (B) $\frac{3}{4}$ (C) $\frac{4}{5}$ (D) 1 (E) 2

Data Interpretation

Directions: For each of the following questions, select the best of the answer choices given.

Numbers: All numbers used are real numbers.

Figures: Figures that accompany these questions are intended to provide information useful in answering the questions. They are drawn as accurately as possible EXCEPT when it is stated in a specific question that its figure is not drawn to scale. All figures lie in a plane unless otherwise indicated.



Of the following four-year periods, in which were there the fewest bank failures?

(A) 1956 through 1959 (B) 1960 through 1963
(C) 1964 through 1967 (D) 1968 through 1971
(E) 1972 through 1975

Appendix C

Review for the Quantitative Section Of the GRE Aptitude Test

GRE
GRADUATE RECORD EXAMINATIONS

REVIEW FOR THE QUANTITATIVE SECTION

OF THE GRE APTITUDE TEST

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Quantitative Ability

The quantitative sections of the Aptitude Test are designed to measure basic mathematical skills, understanding of elementary mathematical concepts, and ability to reason quantitatively and to solve problems in a quantitative setting. The mathematics required does not extend beyond that assumed to be common to the mathematics background of all examinees. There is a balance among the questions requiring arithmetic, algebra, and geometry.

ARITHMETIC

Questions classified as arithmetic can be answered by performing arithmetic operations on numbers (adding, subtracting, multiplying, dividing, and finding powers, roots of powers, percents, and averages), by reasoning, or by a combination of the two.

Some facts about numbers that might be helpful. An odd integer power of a negative number is negative, and an even integer power is positive; for example, $(-2)^3 = -8$, but $(-2)^2 = 4$.

Squaring a number between 0 and 1 (or raising it to a higher power) results in a smaller number; for example, $(\frac{1}{2})^2 = \frac{1}{4}$ and $\frac{1}{4}$ is less than $\frac{1}{2}$.

The integers 0 and 1 have some properties that other numbers do not have; for example, the product of 0 and any number is 0, and the product of 1 and any number is that number.

ALGEBRA

The algebra required does not extend beyond that usually covered in a first-year high school course and includes such topics as properties of odd and even integers, divisibility, factors, and multiples in the system of integers, prime numbers, properties of signed numbers, linear equations and inequalities, factorable quadratic equations, factorization, simplification of algebraic expressions, exponents, and radicals. The skills required include the ability to solve simple equations, the ability to read and set up an equation for solving a complex problem, and the ability to apply basic algebraic skills to solve unfamiliar problems. It is expected that examinees will be familiar with symbols that are conventionally used in elementary algebra, such as the following: $x < y$ (this means that x is less than y), $x \neq y$ (this means that x is not equal to y), $|x|$ (this is defined to be x if $x \geq 0$ and $-x$ if $x < 0$), and $\sqrt{x^2}$ (this denotes the non-negative square root of x^2, that is, $\sqrt{x^2} = |x|$). Nonstandard notation is used only when it is explicitly defined for a particular question.

Don't be surprised if you see some of these on the test.

Some facts about algebra that might be helpful. The sum and product of even and odd integers will be even or odd depending on the operation and the kinds of integers; for example, the sum of an odd integer and an even integer is odd.

Integer = whole number (..., −1, 0, +1 ...)

If an integer P is a divisor or a factor of another integer N, then N is the product of P and another integer and N is said to be an integer multiple of P; for example, 3 is a divisor or a factor of 6, and 6 is an integer multiple of 3.

A prime number is a number that has only two distinct positive divisors, 1 and itself; for example, 2, 3, and 5 are prime numbers, but $9 = 3 \cdot 3$ is not.

A prime can be divided evenly only by itself and by 1.

The sum and product of signed numbers will be positive or negative depending on the operation and the kinds of numbers; for example, the product of a negative number and a positive number is negative.

For any two numbers on the number line, the number on the left is less than the number on the right; for example, $2 < 3$ and $-4 < -3$.

Left is less!

Multiplying an inequality by a negative number reverses the direction of the inequality sign; for example, if the inequality $2 < 4$ is multipled by -2, the resulting inequality will be $-4 > -8$.

The two numbers $\sqrt{x}$ and $|x|$ are never negative; for example $\sqrt{3^2} = \sqrt{(-3)^2} = 3$ and $|-2| = -(-2) = 2$.

Never negative!

If $ab = 0$, then $a = 0$ or $b = 0$; for example, if $x^2 - 1 = 0$, then, since $x^2 - 1 = (x - 1)(x + 1)$, $(x - 1)(x + 1) = 0$ and therefore $x = 1$ or $x = -1$.

An integer exponent on a number indicates the number of times that number is to be multipled together; for example, x^4 means $x \cdot x \cdot x \cdot x$ and, therefore,

$$x^4 \cdot x^3 = (x \cdot x \cdot x \cdot x)(x \cdot x \cdot x) = x^7 \text{ or } \frac{x^4}{x^3} = \frac{x \cdot x \cdot x \cdot x}{x \cdot x \cdot x} = x.$$

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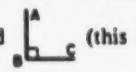
GEOMETRY

The geometry questions are limited primarily to measurement and intuitive geometry or spatial visualization. Although a question may be posed in either English units or metric units of measure, the knowledge required for converting units in one system to units in another system or from one unit to another in the same system will not be tested. If an answer to a question is expected to be a unit of measure different from the unit in which the question is posed, a relationship between the units will be provided in the question. Topics include properties of lines, circles, triangles, rectangles, and other polygons; measurement-related concepts of area, perimeter, volume, and angle measure in degrees; and the Pythagorean theorem. Knowledge of simple coordinate geometry and special triangles such as isosceles, equilateral, and $30° - 60° - 90°$ triangles is also assumed. It is expected that examinees will be familiar with symbols that are conventionally used in elementary geometry, such as the following: $\parallel$ (this means is parallel to), $\perp$ (this means is perpendicular to), and 

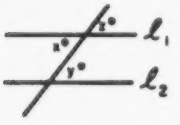
(this means that $\angle ABC$ is a right angle). The ability to construct proofs and knowledge of theorems that are usually learned only in a formal geometry course are not measured.

Notation again!

Some facts about geometry that might be helpful. If two lines intersect, the vertical angles are equal; for example, in the figure

, $x = y$.

opposite angles are equal.

If two parallel lines are intersected by a third line, some of the angles formed are equal; for example, in the figure 

where $\ell_1 \parallel \ell_2$, $y = x = z$.

Equal angles again.

The number of degrees of arc in a circle is 360; for example in the figure

if $x = 60$, then arc ABC is $\frac{60}{360}$ of the circumference of the circle.

Circle = 360°

The sum of the degree measures of the angles of a triangle is 180.

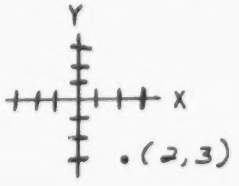
Triangle = 180°

The volume of a rectangular solid or of a right circular cylinder is the product of the area of the base and the height; for example, the volume of a cylinder with base of radius 2 and height 5 is $\pi(2^2)(5) = 20\pi$.

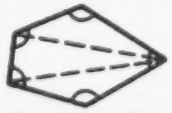
A general rule for volumes.

The square of the hypotenuse of a right triangle is equal to the sum of the squares of the two legs.

The coordinates of a point (x,y) give the location of the point in the coordinate plane; for example, the point $(2, -3)$ is located in the fourth quadrant 2 units to the right of the Y-axis and 3 units below the X-axis.



The sides of a $45° - 45° - 90°$ triangle are in the ratio $1 : 1 : \sqrt{2}$, and the sides of a $30° - 60° - 90°$ triangle are in the ratio $1 : \sqrt{3} : 2$.

Drawing in lines that are not shown in a figure can sometimes help in solving a geometry problem; for example, by drawing the dashed lines in the pentagon 
, the number of degrees in the pentagon can be found by adding up the number of degrees in the three triangles.

The pentagon is three triangles.

Appendix D

Example of One Sample Test

Note: Two such sample tests were available for each test section.

GRE
GRADUATE RECORD EXAMINATIONS

SAMPLE GRE VERBAL TEST A

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Verbal 1

Time–30 minutes
38 Questions

Directions: Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five lettered words or sets of words. Choose the word or set of words for each blank that *best* fits the meaning of the sentence as a whole.

1. Although their ------- has led to increased -------, the basic methods of lithography have not changed since its invention.

   (A) refinement . . speed
   (B) expense . . popularity
   (C) compromise . . invention
   (D) usefulness . . simplicity
   (E) mechanization . . abandonment

2. Price stability and war simply do not go together, and no amount of economic legerdemain can ever ------- this -------.

   (A) demolish . . propensity
   (B) unveil . . canard
   (C) refurbish . . tautology
   (D) resolve . . incompatibility
   (E) conceal . . sophistry

3. Winter sports, particularly skiing, are almost as important to the economy of the area as are ------- activities.

   (A) profitable (B) competitive (C) summertime
   (D) recreational (E) outdoor

4. If sibling rivalry did nevertheless exist, it was effectively ------- by an outward show of mutual -------.

   (A) disguised . . combativeness (B) muted . . deference
   (C) simulated . . cooperation (D) effaced . . mistrust
   (E) evoked . . fraternity

5. In all coal there is an incombustible part, but the ------- that does not burn is generally ------- by indignant users.

   (A) ash . . utilized (B) smoke . . ignored
   (C) residue . . collected (D) proportion . . exaggerated
   (E) element . . isolated

6. He defines appearance as whatever is -------, or subject to time, and defines truth as whatever transcends time.

   (A) infallible (B) powerful (C) empirical
   (D) tactile (E) ephemeral

7. None of his assistants seemed to be quite up to the mark, and there had been so many small failures that even less ------- people than Morrison might be expected to -------.

   (A) magnanimous . . cavil
   (B) punctilious . . condone
   (C) cantankerous . . complain
   (D) pedantic . . acquiesce
   (E) contemptuous . . despair

Directions: In each of the following questions, a related pair of words or phrases is followed by five lettered pairs of words or phrases. Select the lettered pair that best expresses a relationship similar to that expressed in the original pair.

8. SHIP : ARMADA : : (A) navy : army
   (B) commander : orderly (C) offense : defense
   (D) admiral : fleet (E) plane : squadron

9. PLUG : SOCKET : : (A) prong : fork
   (B) cartridge : chamber (C) mitten : glove
   (D) bulb : switch (E) chimney : fire

10. ANNEX : BUILDING : : (A) postscript : letter
    (B) lyric : song (C) paragraph : text
    (D) hill : mountain (E) gate : fence

11. PATHETIC : SYMPATHY : : (A) witty : malice
    (B) sad : anxiety (C) foolish : frivolity
    (D) stupid : ignorance (E) unjust : resentment

12. OFFICIOUSNESS : HELPFULNESS : :
    (A) stinginess : thrift (B) mediocrity : talent
    (C) hypocrisy : feeling (D) obscurity : fame
    (E) learning : scholarliness

13. ROIL : TURBID : : (A) sever : sharp
    (B) knead : tepid (C) defile : impure
    (D) disintegrate : arid (E) terminate : continual

14. PERFUNCTORY : ZEAL : : (A) venerable : wisdom
    (B) diplomatic : tact (C) assiduous : clarity
    (D) profligate : courage (E) precipitate : caution

15. ENTHUSIASTIC : FANATICAL : :
    (A) gregarious : frenzied (B) sensible : sensitive
    (C) singular : unique (D) serene : apathetic
    (E) arduous : laborious

16. DILIGENCE : SLOTH : : (A) patience : snail
    (B) acrimony : shrew (C) innocence : lamb
    (D) speechlessness : magpie (E) voracity : vulture

GO ON TO THE NEXT PAGE.

Directions: Each passage in this group is followed by questions based on its content. After reading a passage, choose the best answer to each question. Answer all questions following a passage on the basis of what is *stated* or *implied* in that passage.

It has been feared that environmental damage will result from the offshore production of oil. One kind of damage anticipated is harm to benthic, or bottom-dwelling, ocean animals from the mechanical silting that would be produced by drill cuttings and pipeline burial. But these disturbances are minor when compared with the silting produced by bottom-trawler fishing. Trawl marks over wide expanses of the continental shelf have commonly been observed from submersible research vessels. Trawling can throw large clouds of silt and clay into suspension, as observed from airplanes flying above trawlers operating over the mud bottom of some inner continental shelves. Ironically, it has also been observed that numerous crabs and fish quickly congregate along trawl marks made on the bottom by vehicle runners and ballast chains; thus, one might even conclude that disturbing the bottom, as well as spilling minor amounts of oil, benefits rather than harms many benthic animals.

17. The primary purpose of the passage is to

    (A) defend offshore oil production from the charge of spilling too much oil
    (B) refute an environmentalist objection to offshore oil production
    (C) describe bottom-trawler fishing as environmentally beneficial
    (D) advocate measures for the protection of bottom-dwelling marine animals
    (E) explain methods used to observe the damage done by trawlers

18. Which of the following statements concerning the crabs and fish that congregate along trawl marks can be inferred from the passage?

    (A) They belong to many species.
    (B) They congregate because they are gregarious in nature.
    (C) They seek to hide along the ridges made by the tracks.
    (D) They are attracted by some feature of the changed environment.
    (E) They depend on the changes produced by trawling to find food.

19. Which of the following is a conclusion suggested by the author for which no evidence is offered in the passage?

    (A) Many benthic animals are benefited by disturbance of the ocean bottom.
    (B) The silting produced by bottom-trawler fishing is more significant than the silting that would be produced in the offshore production of oil.
    (C) Minor spills of oil benefit some species of bottom-dwelling ocean animals.
    (D) Some predictions of environmental damage from the offshore production of oil are exaggerated.
    (E) Bottom-trawling improves the marine environment for some living creatures.

The literary generation that crusaded against Puritanism and the genteel tradition, against stereotypes and sentimentality, also saw what Merle Curti terms "the beginnings of a new and realistic interest in American regions and American folk." The trend toward twentieth-century realism exemplified in this country by the works of Sherwood Anderson, Sinclair Lewis, and Theodore Dreiser was paralleled in the work of Black writers of the same period. Rudolph Fisher, Arna Bontemps, and Jessie Fauset, for example, reached an almost full scale of self-revelation and a substantial degree of self-criticism. By breaking with past literary tradition, Black writers in the 1920's were developing a greater sophistication of style and wider and more universal appeal.

American art faced a problem in the early twenties—a problem born of the fact that for years the White American had regarded the American art scene as unsophisticated, and the Black artist had felt oppressed by the social situation. Frequently escaping to life abroad where new developments in art were taking place, neither contributed much toward the development of a distinctive American art. In the mid-twenties, the same forces that inspired the upsurge of new, more realistic, and unapologetic talent in the other arts inspired changes in the attitude of artists. In addition, of course, the rising tide of modernism in Europe and at home encouraged young Black painters away from traditionalism in both subject matter and style.

Fortunately, as with the parallel movement in literature, this movement in painting did not lead the Black artists into racialist art. On the contrary, it led them into the mainstream. American artists were beginning to develop the Negro theme and subject as new native American material. The older White artists had handled the Negro theme in a somewhat casual and superficial manner. For many young White artists of the twenties, Blacks were the subject of careful and penetrating interpretation. The fact that young White American artists and their young Black contemporaries shared this new interest in Black life was significant. A common ground was established among young artists. The notion of the Black world as a restricted province to which the Black artist was confined was removed. At the same time, the Black artist was challenged to the task of self-revelation and forced to attempt it in competition with other artists. The poise and originality of the young artists of that period and their honest depiction of American life brought them closer to the realization that race was a medium of expression, not an end in itself. For though their work was avowedly racial for the most part, they ranged with an increasing sense of freedom through the universe of a common human art. The strength and vigor of artists like Aaron Douglas, Palmer Hayden, and Hale Woodruff were a reflection of superior advantages and training. Of equal, if not greater, importance was the fact that their spiritual enlargement stemmed from the growing conception of American culture as vitally and necessarily including the materials of Black life.

20. According to the passage, paintings of Blacks by older White artists in the 1920's lacked

(A) originality
(B) stylistic variety
(C) popular approval
(D) evidence of realistic concerns
(E) depth of interpretation

21. The author quotes Merle Curti in order to

(A) support her own analysis of a trend
(B) indicate the ambiguity of her topic
(C) provide a contrasting viewpoint
(D) foreshadow new directions attitudes may take
(E) illustrate past resentment of change

22. It can be inferred that which of the following contributed to the "problem" mentioned in line 15?

I. The popularity of American art abroad
II. The artistic confinement of traditional styles in America
III. A belief that the American art world was provincial

(A) I only (B) II only (C) I and II only
(D) II and III only (E) I, II, and III

23. It can be inferred that, in the early decades of the twentieth century, many American painters went abroad because they

(A) hoped to redress social injustices in America
(B) disliked the trend toward modernism in America
(C) regarded Europe as the place where new developments in art were taking place
(D) wished to encourage Europeans to join the movement toward realism
(E) could find no way to support themselves in America

24. Which of the following best defines the "common ground" mentioned in line 39?

(A) A desire for honest self-revelation in painting
(B) A confidence in the influence of art on society
(C) An interest in improving the quality of life in America
(D) A concern for realistic interpretation of Black life in art
(E) A new freedom to depict subject matter unrelated to American life

25. The author's primary purpose in the passage is to

(A) analyze the effects on Black artists of the movement toward realism in art
(B) explain the differences between realism in literature and realism in painting
(C) contrast the works of Black artists with those of their White contemporaries
(D) enumerate several dilemmas faced by Black artists in America
(E) encourage the inclusion of Black life in artistic depictions of American culture

26. The author mentions Sinclair Lewis and Jessie Fauset as examples of writers who

(A) awakened European interest in American culture
(B) broke away from past literary traditions
(C) portrayed the lives of Blacks realistically
(D) were among the most prolific writers of the 1920's
(E) influenced artists in fields other than literature

27. Which of the following titles best summarizes the content of the passage?

(A) The History of Black People as Portrayed in American Art
(B) The Political Forces Behind the Trend Toward Realism in Art in the 1920's
(C) Realism in the Arts and Its Relationship to the Black Artist
(D) Why Realism in Literature Influenced American Painters in the 1920's
(E) The Differences Between Traditionalism and Realism in American Art

Directions: Each question below consists of a word printed in capital letters, followed by five lettered words or phrases. Choose the lettered word or phrase that is most nearly *opposite* in meaning to the word in capital letters.

Since some of the questions require you to distinguish fine shades of meaning, be sure to consider all the choices before deciding which one is best.

28. DEPLORABLE : (A) mildly invigorating (B) rarely available (C) indivisible (D) intangible (E) praiseworthy

29. TICKLE : (A) admit (B) surprise (C) stretch (D) bore (E) close

30. SUBTLETY : (A) extremity (B) obviousness (C) depravity (D) caricature (E) erudition

31. MISCHANCE : (A) fair decision (B) good fortune (C) subtle change (D) valid assumption (E) correct response

32. CONTROVERT : (A) affirm (B) progress (C) transfer smoothly (D) observe carefully (E) experiment boldly

33. INTERDICT : (A) extend (B) detract (C) submit (D) replenish (E) allow

34. OBFUSCATE : (A) portend (B) rejuvenate (C) illuminate (D) intensify (E) maximize

GO ON TO THE NEXT PAGE.

35. DOWDY : (A) graceful (B) minute
(C) precocious (D) spruce (E) wealthy

36. STOLIDITY : (A) confidence (B) weakness
(C) intelligence (D) excitability (E) dishonesty

37. INSOUCIANCE : (A) knowledgeability (B) trust
(C) impartiality (D) affluence (E) concern

38. SALUBRIOUS : (A) unfriendly (B) reprehensible
(C) noxious (D) saccharine (E) corrosive

STOP

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY.
DO NOT WORK ON ANY OTHER SECTION IN THE TEST.

Verbal 2

Time–30 minutes
38 Questions

Directions: Each sentence below has one or two blanks, each blank indicating that something has been omitted. Beneath the sentence are five lettered words or sets of words. Choose the word or set of words for each blank that *best* fits the meaning of the sentence as a whole.

1. This book depicts the groping futility that permeates the lives of Americans surrounded by poverty and makes us ------- realities we would prefer to ignore.

   (A) elude (B) shelve (C) nurture
   (D) confront (E) emulate

2. The problems of unused talents and noticeable ------- effort and reward continue to frustrate women.

   (A) affinities for (B) analyses of
   (C) additions to (D) renumerations for
   (E) discrepancies between

3. Although he survived typhoons, earthquakes, and other -------, he succumbed, -------, to the common cold.

   (A) cataclysms . . ironically (B) hazards . . unwittingly
   (C) disasters . . naturally (D) difficulties . . unerringly
   (E) plagues . . expectedly

4. Although its resemblance to the lizard family is -------, the tuatara was at one time classified as a kind of lizard.

   (A) arbitrary (B) sensational (C) superficial
   (D) significant (E) exceptional

5. In spite of medieval England's political and economic -------, a contemporary traveler would doubtless have noted many ------- local customs.

   (A) unity . . different (B) insularity . . restrictive
   (C) independence . . traditional (D) problems . . strange
   (E) moderation . . colorful

6. Americans tend to equate public greatness with private goodness, even though it is so obvious that private ------- is in no way ------- to public usefulness.

   (A) integrity . . superior (B) rectitude . . tantamount
   (C) piety . . irrelevant (D) improbity . . equivalent
   (E) dissipation..comparable

7. Inertia ------- the role of action in the play; the prevailing mood is one of -------.

   (A) elicits . . secrecy (B) precludes . . suspicion
   (C) assumes . . fury (D) characterizes . . fear
   (E) usurps . . torpor

Directions: In each of the following questions, a related pair of words or phrases is followed by five lettered pairs of words or phrases. Select the lettered pair that best expresses a relationship similar to that expressed in the original pair.

8. REFEREE : SPORT : : (A) senator : congress
   (B) moderator : debate (C) floorwalker : merchandise
   (D) analyst : psychology (E) host : party

9. SUITE : FURNITURE : : (A) vase : pottery
   (B) fodder : livestock (C) flavor : food
   (D) landscape : picture (E) ensemble : clothing

10. GYROSCOPE : BALANCE : : (A) wheel : road
    (B) sail : wind (C) motor : fuel
    (D) rudder : direction (E) bicycle : pedal

11. ANODYNE : PAIN : : (A) rain : drought
    (B) restorative : hearing (C) emotion : anger
    (D) chill : tremor (E) strain : ligament

12. RECANT : BELIEF : : (A) rescind : order
    (B) negate : cancellation (C) reword : hypothesis
    (D) rebuke : behavior (E) abominate : evildoing

13. MOTE : DUST : : (A) plethora : thoughts
    (B) morsel : food (C) volume : goods
    (D) dose : medicine (E) lamp : light

14. PRETERNATURAL : NORMAL : :
    (A) hyperbolic : related
    (B) gesticulative : indicated
    (C) ubiquitous : accepted
    (D) lamentable : regretted
    (E) supererogatory : required

15. HERO : KUDOS : : (A) audience : applause
    (B) scapegoat : blame (C) judge : verdict
    (D) censor : insult (E) snob : rebuff

16. SQUABBLE : FIGHT : : (A) injustice : defiance
    (B) mistake : punishment (C) prattle : speech
    (D) detour : delay (E) topic : conversation

GO ON TO THE NEXT PAGE.

Directions: Each passage in this group is followed by questions based on its content. After reading a passage, choose the best answer to each question. Answer all questions following a passage on the basis of what is *stated* or *implied* in that passage.

The measured values of the mass and radius of Pluto provide an interesting paradox. Since the planet does not have a satellite, the only way to determine its mass is from the perturbations it causes in the orbits of Neptune and Uranus. From such data, the mass has been estimated to be somewhat less than that of Earth. In 1956, G. P. Kuiper and M. Humason measured the angular diameter of Pluto and found it to be 0.23 second of arc; at the existing distance, this represented a diameter of about 5,800 kilometers; i.e., a radius of 2,900 kilometers (1,800 miles) for the planet. From the estimated mass and the radius given above, the density is found to have the unrealistic value of nearly 60 grams per cubic centimeter.

One way out of the difficulty is the suggestion that Pluto has a very smooth surface, unlike that of any other member of the solar system, and that this reflects light in a specular manner; i.e., like a polished sphere. In this case, the angular diameter measured would be that of the reflected image of the Sun, which would be smaller than the true angular diameter. The actual diameter of Pluto might thus be appreciably greater than 5,800 kilometers, and the density would be considerably less than the value given above. An error of a factor of two in the diameter would decrease the density by a factor of eight. There is, however, no reason to believe that the surface of Pluto is smooth enough to cause specular reflection of sunlight.

An alternative possibility is that the mass of the planet calculated from the perturbations of the orbits of Uranus and Neptune is too large; in other words, the perturbations have been overestimated. If the density of Pluto is assumed to be about 3.5 grams per cubic centimeter, which is roughly that of Neptune's satellite, Triton, and the diameter is taken as 5,800 kilometers, the mass would be about one-eighteenth (0.057) of the mass of Earth. A body with such a small mass would not have produced the apparent perturbation of the orbit of Uranus upon which was based the prediction of the existence of Pluto. If such is the case, the discovery of this planet was a fortunate accident. There is now no simple way of deciding whether either the mass based on the orbital perturbations or the radius derived from the observed angular diameter is correct. One way to resolve the uncertainty is by means of a space probe with a large telescope oriented to observe the eclipse by Pluto of a suitable star. An unequivocal value of the diameter of the planet could, in principle, be obtained in this manner.

17. According to the passage, the density of Triton is approximately

(A) the same as that of Neptune
(B) the same as that of Earth
(C) one-eighteenth of the density of Earth
(D) 3.5 grams per cubic centimeter
(E) 60 grams per cubic centimeter

18. The author regards the idea that the surface of Pluto is smooth with

(A) bewilderment (B) skepticism (C) apprehension (D) enthusiasm (E) derision

19. It can be inferred from the passage that if Pluto had a satellite, astronomers could more accurately determine the

(A) mass of Pluto
(B) specularity of Pluto
(C) orbit of Pluto
(D) nature of the satellites of Neptune and Uranus
(E) orbits of Neptune and Uranus

20. The author's primary purpose in the passage is to

(A) trace the development of a theory
(B) question given data
(C) criticize inaccurate calculations
(D) describe an unresolved dilemma
(E) propose an innovative solution

21. It can be inferred that if Kuiper and Humason had found the diameter of Pluto to be 11,600 kilometers, they would have calculated the density of Pluto to be about how many grams per cubic centimeter?

(A) 2 (B) 7 (C) 15 (D) 120 (E) 480

22. Which of the following best summarizes the "paradox" mentioned in line 2?

(A) Although scientists have made many attempts, there is no way to prove or disprove the theory that Pluto is the only member of the solar system with a very smooth surface.
(B) Evidence of the perturbation that Pluto causes in the orbit of Neptune conflicts with pre-1956 assumptions about the mass of Pluto.
(C) Calculations of Pluto's density based on observation and reasonable estimation contradict realistic expectations of what the density should be.
(D) The accuracy of measurements of Pluto's radius can be validated only by accurate measurements of the mass of the planet.
(E) The existence of Pluto has been accepted despite the absence of and inaccuracy of evidence concerning its major characteristics.

23. According to the passage, if Pluto has a very smooth surface, which of the following is true of the angular diameter of Pluto as measured by Kuiper and Humason?

(A) It is larger than the true angular diameter.
(B) It is an accurate calculation of the diameter.
(C) It is the same as the angular diameter of the Sun.
(D) It is approximately one-eighth the true angular diameter.
(E) It is the angular diameter of the reflected image of the Sun.

24. The discovery of Pluto could most appropriately be described as "a fortunate accident" (line 38) if

(A) the mass of Earth were 18 times the mass of Pluto
(B) the density of Triton had been overestimated in astronomers' calculations
(C) the mass of Neptune had been overestimated in astronomers' calculations
(D) observed perturbations in the orbit of Uranus were caused by the planet Pluto
(E) the surface of Pluto were very smooth

A plausible case can be made for the view that personal values influence which things in the environment a person attends to. Obviously, a person cannot look in all directions at once, and I will not choose to look at the same things you choose to look at. But an extension of the principle was made by those perceptionists who argued that personal values not only orient perception, but actually distort it. I distrust the generalization that perception is typically distorted, because I think the biological need for clear perception is so great that evolution would have weeded out such a tendency. However, the argument does appear to have some bearing on the study of perception in general.

25. According to the passage, the perceptionists mentioned in line 6 are guilty of

(A) inability to reconcile conflicting viewpoints
(B) unwillingness to consider new evidence
(C) careless experimentation
(D) deliberate falsification
(E) inappropriate extrapolation

26. The author provides information to answer which of the following questions?

(A) What kinds of values most affect personal perceptions?
(B) What evidence is there that personal values distort perception?
(C) How do people decide which things in the environment to attend to?
(D) Why is it unlikely that perception is typically distorted?
(E) What effect has the distortionist argument had on the study of perception?

27. The argument mentioned in the last sentence is best summarized by which of the following statements?

(A) Personal values typically orient perception.
(B) Evolution has had an effect on human perceptual ability.
(C) There is a biological need for clear perception.
(D) People choose to look at different things in the environment.
(E) Personal values typically distort perception.

Directions: Each question below consists of a word printed in capital letters, followed by five lettered words or phrases. Choose the lettered word or phrase that is most nearly *opposite* in meaning to the word in capital letters.

Since some of the questions require you to distinguish fine shades of meaning, be sure to consider all the choices before deciding which one is best.

28. MOBILIZE : (A) expose (B) disband (C) disavow (D) conquer (E) minimize

29. PINNACLE : (A) lowest point (B) smallest number (C) endless time (D) vigorous effort (E) loud noise

30. ENDOW : (A) condemn (B) mystify (C) impoverish (D) exhilarate (E) complete

31. TUMULT : (A) individuality (B) repose (C) origin (D) sparse growth (E) poor adaptation

32. PIVOTAL : (A) untimely (B) informal (C) incidental (D) unsaturated (E) disproportionate

33. ABSTEMIOUS : (A) sacred (B) approachable (C) relaxed (D) giving generously (E) partaking freely

34. PROMULGATE : (A) distort (B) demote (C) retard (D) suppress (E) discourage

35. REFRACTORY : (A) undetermined (B) disinterested (C) docile (D) identifiable (E) rambling

36. MORIBUND : (A) dormant (B) dominant (C) nascent (D) absent (E) crescent

37. SALACIOUS : (A) anemic (B) puritanical (C) despotic and cruel (D) ignorant and foolish (E) accurate and appropriate

38. CONCATENATION : (A) disconnectedness (B) euphony (C) inertness (D) apparentness (E) homogeneity

STOP

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY CHECK YOUR WORK ON THIS SECTION ONLY.
DO NOT WORK ON ANY OTHER SECTION IN THE TEST.

ANSWER KEY FOR SAMPLE APTITUDE TEST

Verbal 1	Verbal 2
1. A	1. D
2. D	2. E
3. C	3. A
4. B	4. C
5. D	5. A
6. E	6. B
7. C	7. E
8. E	8. B
9. B	9. E
10. A	10. D
11. E	11. A
12. A	12. A
13. C	13. B
14. E	14. E
15. D	15. B
16. D	16. C
17. B	17. D
18. D	18. B
19. C	19. A
20. E	20. D
21. A	21. B
22. D	22. C
23. C	23. E
24. D	24. A
25. A	25. E
26. B	26. D
27. C	27. E
28. E	28. B
29. D	29. A
30. B	30. C
31. B	31. B
32. A	32. C
33. E	33. E
34. C	34. D
35. D	35. C
36. D	36. C
37. E	37. B
38. C	38. A

Appendix E

Letters of Encouragement and Nonencouragement

Encouraging Letter 1: Popular Press

EDUCATIONAL TESTING SERVICE PRINCETON, N.J. 08541

609-921-9000
CABLE-EDUCTESTSVC

DIVISION OF EDUCATIONAL
RESEARCH AND EVALUATION

Dear GRE Candidate:

We are writing to you because you have registered to take the GRE Aptitude Test on December 12, 1981. We are conducting research on the effects of special preparation on test scores and have enclosed materials that we would like to encourage you to study for the upcoming test. Last year we sent test preparation materials for the analytical section of the test to a sample of GRE test takers. Although not everyone benefited, test takers who were encouraged to prepare for the test obtained, on the average, significantly higher analytical scores than those who were not encouraged. From this, we concluded that the use of test preparation materials we sent to test takers for the analytical section of the GRE Aptitude Test had a positive impact on analytical test performance. Currently, we are investigating the effects of using test preparation materials for the verbal and the math sections of the test, as well as for the analytical section.

Recently, the issue of special test preparation has been in the news frequently. Some headlines have suggested positive effects of special preparation. Here's what a few of them have had to say.

Are standardized admissions tests susceptible to special test preparation?

...You can Study for Aptitude Tests--The Hartford Advocate, June 20, 1979.

(Reports that an FTC study shows that "...coaching can indeed help improve student scores.")

...Standardized Tests are Coachable--NEA Reporter, May, 1979.

(Quotes a former ETS researcher as saying "...providing instruction for test-taking helps the student from being beaten by the test.")

...Do Preparation Courses Help Students on Tests?--The Washington Star, May, 1979.

(The answer given is: "Test-taking is a skill. There's an art to it. The more you take tests, the better you're going to get at it.")

...ETS Concedes Special Preparation Can Boost Test Scores--The Chronicle of Higher Education, September 15, 1980.

(Reports that two Harvard researchers argue that ETS has conceded that training "over a period of weeks or months" can lead to notable score improvements.)

Can students prepare effectively on their own or with special help?

...Teacher: Coaching Helps Test Scores--Dallas Times Herald, December 24, 1979.

(Reports one teacher's efforts to help students improve admission test scores.)

...Students, You're Your Own Best 'Coach.'--The Philadelphia Evening Bulletin, June 4, 1979.

("As with most things, taking a test is a matter of knowing what to expect and being prepared.")

...Cram! There's a Difference Between Learning a Subject and Taking a Test.--Forbes Magazine, October 16, 1978.

(Suggests that "...learning how to take a test should be a legitimate part of any curriculum that prepares a student for the real world...")

Are these headlines typical?

We're not suggesting that newspaper accounts are always completely accurate, but we think they do point out the helpfulness of preparing for tests. Neither do we claim that all newspaper stories have been so positive about special test preparation. However, they are consistent with our findings that, as a group, GRE test takers who used our materials last year did significantly better on the question types that were covered. By far the biggest effect resulted from getting students to really use the materials that were available to them.

Partly because of these findings, some question types have changed this year. Also, some of the materials we are sending you now are different from those sent in the previous study. Although many can now also be found in the expanded test preparation materials available to all GRE test takers, we have reprinted them for your convenience and to emphasize their importance in preparing for the test. We believe that studying them will enable you to approach the test with more confidence and less apprehension, and thus have a better chance of obtaining higher scores than you might have otherwise.

We will be writing to you again as soon as you have taken the test in order to determine your use of, and reaction to, the materials. Thank you and good luck next month.

Sincerely,

Don Powers

Donald E. Powers

Spencer Swinton

Spencer S. Swinton
Test Preparation
Project Directors

Encouraging Letter 2: Examinee Testimonials

EDUCATIONAL TESTING SERVICE PRINCETON, N.J. 08541

609-921-9000
CABLE-EDUCTESTSVC

DIVISION OF EDUCATIONAL
RESEARCH AND EVALUATION

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As you are most likely aware, the topic of the effects of test preparation on test performance is both complex and controversial. Nonetheless, it is interesting to note that some students who used these test preparation materials for the analytical portion of the GRE Aptitude Test last year had favorable responses to the materials. Here's what a few of them had to say.

What were students' general reactions?

...I felt the pre-study materials were a tremendous help.--M.M., Charlotte, NC

...I thought the preparatory materials sent to me were excellent.--F.B., Reading, PA

...I feel the sample material I received helped me to be better prepared. I feel more information to others would be extremely helpful to them.--R.A., Travelers Rest, SC

...I appreciated the material you sent and feel it helped me increase my speed and improve my score.--B.W., Reedsburg, WI

...My anxieties were reduced just by knowing what to expect and how to deal with various question types.--S.P., Nantick, MA

...More than anything else, the preparation materials you sent helped me in understanding the directions and how to think through the problems.--G.R., Fort Riley, KS

What were the results?

We don't claim that all test takers were so positive about our materials. However, as a group, GRE test takers who used our materials last year did significantly better on the question types that were covered. By far the biggest effect resulted from getting students to really use the materials that were available to them.

Partly because of these findings, some question types have changed this year. Also, some of the materials we are sending you now are different from those sent in the previous study. Although many can now also be found in the expanded test preparation materials available to all GRE test takers, we have reprinted them for your convenience and to emphasize their importance in preparing for the test. We believe that studying them will enable you to approach the test with more confidence and less apprehension, and thus have a better chance of obtaining higher scores than you might have otherwise.

We will be writing to you again as soon as you have taken the test in order to determine your use of, and reaction to, the materials. Thank you and good luck next month.

Sincerely,

Don Powers

Donald E. Powers

Spencer S. Swinton

Spencer S. Swinton
Test Preparation
Project Directors

B

Encouraging Letter 3: Research Results

EDUCATIONAL TESTING SERVICE PRINCETON, N.J. 08541

609-921-9000
CABLE-EDUCTESTSVC

DIVISION OF EDUCATIONAL
RESEARCH AND EVALUATION

Dear GRE Candidate:

We are writing to you because you have registered to take the GRE Aptitude Test on December 12, 1981. We are conducting research on the effects of special preparation on test scores and have enclosed materials that we would like to encourage you to study for the upcoming test. Last year we sent test preparation materials for the analytical section of the test to a sample of GRE test takers. Although not everyone benefited, test takers who were encouraged to prepare for the test obtained, on the average, significantly higher analytical scores than those who were not encouraged. From this, we concluded that the use of test preparation materials we sent to test takers for the analytical section of the GRE Aptitude Test had a positive impact on analytical test performance. Currently, we are investigating the effects of using test preparation materials for the verbal and the math sections of the test, as well as for the analytical section.

Some research studies have suggested positive effects of special preparation, particularly for test takers who devote significant time and effort. Here's what a few studies have found.

What about special preparation for particular question types?

...Evans, F.R. and Pike, L.W. The effects of instruction for three mathematics item formats. Journal of Educational Measurement, 1973, 10, 257-272.

Students' performance on each of three SAT mathematics question types, which are also in the GRE Aptitude Test, was improved by special instruction for each question type.

What about test preparation offered by commercial companies?

...Federal Trade Commission. Effects of coaching on standardized admission examinations. Washington, DC: Federal Trade Commission, Bureau of Consumer Protection, March 1979.

Analyses of data on the effects of commercial coaching for the SAT revealed average effects at one school of about 30 points for verbal and 20 points for math while data from a second commercial coaching school showed no significant effect on test scores.

What about special effort?

...Messick, S. and Jungeblut, A. Time and method in coaching for the SAT. Psychological Bulletin, 1981, 89, 191-216.

After reviewing coaching studies for the Scholastic Aptitude Test, the authors concluded that "...improvement of the comprehension and reasoning skills measured by the SAT, when it occurs, is a function of the time and effort expended and that each additional score increase may require increasing amounts of time and effort..."

What about self-study?

...Swinton, S.S. and Powers, D.E. The effects of special preparation on GRE analytical scores and item types. Journal of Educational Psychology, in press.

Special preparation had a significant effect on GRE analytical scores. The authors suggested that the preparation that was given contained no "tricks" and that "any candidate who took the sample test under timed conditions, learned instructions for item formats completely, thought carefully about the rationale behind correct answers, and applied pacing and guessing strategies as given in the GRE Information Bulletin, would probably have done as well on the analytical section as did the experimental group."

Are these results typical?

We're not suggesting that all research studies have shown such positive results for special test preparation. The studies have found only that special preparation can help some students for some kinds of question types. The important point is that, as a group, GRE test takers who used our materials last year did significantly better on the question types that were covered. By far the biggest effect resulted from getting students to really use the materials that were available to them.

Partly because of these findings, some question types have changed this year. Also, some of the materials we are sending you now are different from those sent in the previous study. Although many can now also be found in the expanded test preparation materials available to all GRE test takers, we have reprinted them for your convenience and to emphasize their importance in preparing for the test. We believe that studying them will enable you to approach the test with more confidence and less apprehension, and thus have a better chance of obtaining higher scores than you might have otherwise.

We will be writing to you again as soon as you have taken the test in order to determine your use of, and reaction to, the materials. Thank you and good luck next month.

Sincerely,

Don Powers

Donald E. Powers

Spencer Swinton

Spencer S. Swinton
Test Preparation
Project Directors

Nonencouraging Letter

EDUCATIONAL TESTING SERVICE PRINCETON, N.J. 08541

609-921-9000
CABLE-EDUCTESTSVC

DIVISION OF EDUCATIONAL
RESEARCH AND EVALUATION

Dear GRE Candidate:

We are writing to you because you have registered to take the GRE Aptitude Test in December, 1981. Enclosed please find some practice tests for use in your preparation for the test. These tests are some of those that are now being made available to all GRE test candidates.

We would like to contact you after you take the test to see if these practice tests were helpful.

Thank you.

Sincerely,

Don Powers

Donald E. Powers

Spencer S. Swinton

Spencer S. Swinton
Project Directors

DEP:SSS/ls

Enclosures